

P-69

# AERONAUTICAL ENGINEERING

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ENGINEERING: A CONTINUING  
BIBLIOGRAPHY WITH INDEXES  
(SUPPLEMENT 302) (NASA) 69 p

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A CONTINUING BIBLIOGRAPHY WITH INDEXES



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March 1994

# AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES



National Aeronautics and Space Administration  
Scientific and Technical Information Program  
Washington, DC

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# INTRODUCTION

This issue of *Aeronautical Engineering — A Continuing Bibliography with Indexes* (NASA SP-7037) lists 152 reports, journal articles, and other documents recently announced in the NASA STI Database.

Accession numbers cited in this issue include:

*Scientific and Technical Aerospace Reports (STAR)* (N-10000 Series)

Open Literature (A-10000 Series)

N94-20344 — N94-22701

None in this issue

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number—are included.

A cumulative index for 1994 will be published in early 1995.

Information on availability of documents listed, addresses of organizations, and CASI price schedules are located at the back of this issue.



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## TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED

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ACCESSION NUMBER → N94-10675\*# National Aeronautics and Space Administration. ← CORPORATE SOURCE  
Langley Research Center, Hampton, VA.  
TITLE → **STATIC INTERNAL PERFORMANCE OF A SINGLE  
EXPANSION RAMP NOZZLE WITH MULTIAXIS THRUST  
VECTORING CAPABILITY**  
AUTHORS → FRANCIS J. CAPONE and ALBERTO W. SCHIRMER (George Washington Univ., Hampton, VA.) Washington Jul. 1993 ← PUBLICATION DATE  
272 p  
CONTRACT NUMBER → (Contract RTOP 505-62-30-01)  
REPORT NUMBERS → (NASA-TM-4450; L-17163; NAS 1.15:4450) Avail: CASI HC A12/ ← AVAILABILITY AND  
MF A03 PRICE CODE

An investigation was conducted at static conditions in order to determine the internal performance characteristics of a multiaxis thrust vectoring single expansion ramp nozzle. Yaw vectoring was achieved by deflecting yaw flaps in the nozzle sidewall into the nozzle exhaust flow. In order to eliminate any physical interference between the variable angle yaw flap deflected into the exhaust flow and the nozzle upper ramp and lower flap which were deflected for pitch vectoring, the downstream corners of both the nozzle ramp and lower flap were cut off to allow for up to 30 deg of yaw vectoring. The effects of nozzle upper ramp and lower flap cutout, yaw flap hinge line location and hinge inclination angle, sidewall containment, geometric pitch vector angle, and geometric yaw vector angle were studied. This investigation was conducted in the static-test facility of the Langley 16-foot Transonic Tunnel at nozzle pressure ratios up to 8.0. Author (revised)

## TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

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ACCESSION NUMBER → A94-10806\* National Aeronautics and Space Administration. ← CORPORATE SOURCE  
Langley Research Center, Hampton, VA.  
TITLE → **FLIGHT CONTROL APPLICATION OF NEW STABILITY  
ROBUSTNESS BOUNDS FOR LINEAR UNCERTAIN SYSTEMS**  
AUTHOR → RAMA K. YEDAVALLI (Ohio State Univ., Columbus) Journal of ← AUTHOR'S AFFILIATION  
Guidance, Control, and Dynamics (ISSN 0731-5090) vol. 16, no. 6 AND JOURNAL TITLE  
PUBLICATION DATE → Nov.-Dec. 1993 p. 1032-1037. refs  
CONTRACT NUMBER → (Contract NAG1-1164)  
Copyright

This paper addresses the issue of obtaining bounds on the real parameter perturbations of a linear state-space model for robust stability. Based on Kronecker algebra, new, easily computable sufficient bounds are derived that are much less conservative than the existing bounds since the technique is meant for only real parameter perturbations (in contrast to specializing complex variation case to real parameter case). The proposed theory is illustrated with application to several flight control examples.

# AERONAUTICAL ENGINEERING

*A Continuing Bibliography (Suppl. 302)*

March 1994

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## AERONAUTICS (GENERAL)

**N94-21194#** Wright Lab., Wright-Patterson AFB, OH.  
**THE 1992 USAF STRUCTURAL INTEGRITY PROGRAM**  
**CONFERENCE Final Report**

THOMAS D. COOPER, JOHN W. LINCOLN, and ROBERT M.  
BADER Sep. 1993 894 p Conference held in San Antonio,  
TX, 1-3 Dec. 1992

(AD-A272876; WL-TR-93-4080) Avail: CASI HC A99/MF A10

Partial contents include the following: new developments in fatigue management of F-16 aircraft; quantifying accuracy of fatigue life prediction methodology; naval aircraft approach and landing data acquisition system; a diagnostic reasoning technology demonstrator for gas turbine engines; cost effective risk management in design and flight qualification; a preliminary study of fatigue durability in terms of crack growth; a fatigue analysis of panels with multiple site damage; probabilistic rotor design system; assessment of helicopter component statistical reliability computations; the effects of negative R ratio on fatigue crack growth; effect of microporosity on fatigue durability of thick 7050 aluminum plate; fatigue and residual strength characteristics of fiber metal laminates subjected to incidental damage; the role of nondestructive inspection in an F-15E wing spar structural integrity program; ultrasonic imaging system for F-4 lower torque box skin; acoustic emission monitoring of the CF116 (CF5) full-scale durability and damage tolerance test; vibratory characterization of integrally bladed rotors utilizing surrogate blade models; F-4 lower wing skin integral stiffener failure analysis; new aircraft lower wing skin trade study; C-141 composite material repairs to metallic airframe components; and repair of F-16 static discharge probes. DTIC

**N94-21419#** Aerospace Industries Association of America, Inc.,  
Washington, DC.

**AEROSPACE: FACTS AND FIGURES, 1992-1993**

1992 177 p

(AD-A272571) Avail: CASI HC A09/MF A02

Contents of the document include the following: aerospace summary, aircraft production, missile programs, space programs, air transportation, research and development, foreign trade, employment, and finance. DTIC

**N94-21490\*#** National Aeronautics and Space Administration.  
Ames Research Center, Moffett Field, CA.

**THE MODERN ROTOR AERODYNAMIC LIMITS SURVEY: A  
REPORT AND DATA SURVEY**

J. CROSS, J. BRILLA, R. KUFELD, and D. BALOUGH Oct.  
1993 261 p

(Contract RTOP 505-59-36)

(NASA-TM-4446; A-91183; NAS 1.15:4446) Avail: CASI HC  
A12/MF A03

The first phase of the Modern Technology Rotor Program, the Modern Rotor Aerodynamic Limits Survey, was a flight test conducted by the United States Army Aviation Engineering Flight Activity for NASA Ames Research Center. The test was performed

using a United States Army UH-60A Black Hawk aircraft and the United States Air Force HH-60A Night Hawk instrumented main-rotor blade. The primary purpose of this test was to gather high-speed, steady-state, and maneuvering data suitable for correlation purposes with analytical prediction tools. All aspects of the data base, flight-test instrumentation, and test procedures are presented and analyzed. Because of the high volume of data, only select data points are presented. However, access to the entire data set is available upon request. Author (revised)

02

## AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

**N94-20465#** Lehigh Univ., Bethlehem, PA. Dept. of Mechanical  
Engineering and Mechanics.

**A THEORETICAL INVESTIGATION OF UNSTEADY  
SEPARATION PHENOMENA RELATED TO DYNAMIC STALL**  
**Final Report, 11 Jan. 1990 - 30 Apr. 1993**

J. D. WALKER 30 Apr. 1993 15 p

(Contract AF-AFOSR-0069-91)

(AD-A271865; AFOSR-93-0822TR) Avail: CASI HC A03/MF A01

The objective of this research was to identify the principal cause and effect relationships in dynamic stall at large Reynolds numbers, as well as possible means for controlling the process. At high Reynolds numbers, it is demonstrated the formation of the dynamic stall vortex initiates for all airfoil shapes via an unsteady separation of the boundary layer near the leading edge. The stall vortex ultimately detaches from the upper surface by provoking an unsteady separation of the surface layer near midchord. At least two methods of controlling separation at various stages in the cycle have been identified, namely: (1) suction near the leading nose or at midchord; and (2) a moving portion of the surface. The present work shows how separation can be suppressed and makes significant contributions to the theory of unsteady boundary-layer separation. A general analysis of unsteady two-dimensional airfoil maneuvers was initiated and is currently under study as a possible third means of control. DTIC

**N94-20486** Army Aviation Systems Command, Moffett Field, CA.  
Aeroflightdynamics Directorate.

**AN EXPERIMENTAL INVESTIGATION OF THE DRAG  
MECHANISMS OF A HELICOPTER ROTOR IN HOVERING  
FLIGHT**

M. SILVA, D. FAVIER (Institut de Mecanique des Fluides de  
Marseille, France.), J. RAMOS (Institut de Mecanique des Fluides  
de Marseille, France.), M. NSI (Institut de Mecanique des Fluides  
de Marseille, France.), and E. BERTON (Institut de Mecanique  
des Fluides de Marseille, France.) Sep. 1993 15 p Limited  
Reproducibility: More than 20% of this document may be affected  
by microfiche quality

(AD-A270201; PAPER-C18) Avail: CASI HC A03

The present paper describes an experiment in which laser velocimetric methods are employed to investigate the drag

## 02 AERODYNAMICS

mechanisms of a helicopter rotor in hover. Emphasis is on the development of a measurement technique capable of quantifying, the contribution of rotor profile drag to total power required. The scheme devised employs a 2-D LV system to measure the axial and tangential velocity field in the vicinity of the rotor blade. Application of a combined Kutta and Momentum Equation (KME) along a closed contour surrounding the blade section provides a measure of the local sectional normal and shear forces. A detailed survey of the rotor blade's near wake region is then performed in an attempt to directly determine the streamwise, velocity deficit. Integration of the resulting velocity profiles provides a measure of the profile drag. Accuracy of the method is checked by performing measurements at conditions of very low lift and by introducing blade surface modifications which aggravate the profile drag with accompanying comparisons of the effect on sectional and global performance. DTIC

**N94-20534\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

### **SOME PRACTICAL TURBULENCE MODELING OPTIONS FOR REYNOLDS-AVERAGED FULL NAVIER-STOKES CALCULATIONS OF THREE-DIMENSIONAL FLOWS**

TRONG T. BUI Nov. 1993 40 p Presented at the 24th Fluid Dynamics Conference, Orlando, FL, 6-9 Jul. 1993; sponsored by AIAA See also N93-48158

(Contract RTOP 505-62-52)

(NASA-TM-106399; E-8231; NAS 1.15:106399; AIAA PAPER 93-2964) Avail: CASI HC A03/MF A01

New turbulence modeling options recently implemented for the 3-D version of Proteus, a Reynolds-averaged compressible Navier-Stokes code, are described. The implemented turbulence models include: the Baldwin-Lomax algebraic model, the Baldwin-Barth one-equation model, the Chien k-epsilon model, and the Launder-Sharma k-epsilon model. Features of this turbulence modeling package include: well documented and easy to use turbulence modeling options, uniform integration of turbulence models from different classes, automatic initialization of turbulence variables for calculations using one- or two-equation turbulence models, multiple solid boundaries treatment, and fully vectorized L-U solver for one- and two-equation models. Validation test cases include the incompressible and compressible flat plate turbulent boundary layers, turbulent developing S-duct flow, and glancing shock wave/turbulent boundary layer interaction. Good agreement is obtained between the computational results and experimental data. Sensitivity of the compressible turbulent solutions with the method of  $y(\text{sup} +)$  computation, the turbulent length scale correction, and some compressibility corrections are examined in detail. The test cases show that the highly optimized one- and two-equation turbulence models can be used in routine 3-D Navier-Stokes computations with no significant increase in CPU time as compared with the Baldwin-Lomax algebraic model.

Author

**N94-20563\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

### **DEVELOPMENT OF PHASED TWIN FLIP-FLOP JETS**

GANESH RAMAN (Sverdrup Technology, Inc., Brook Park, OH.) and EDWARD J. RICE Nov. 1993 10 p Proposed for presentation at the ASME Winter Annual Meeting, New Orleans, LA, 28 Nov. - 3 Dec. 1993; sponsored by ASME

(Contract NAS3-25266; RTOP 505-62-52)

(NASA-TM-106404; E-7609; NAS 1.15:106404) Avail: CASI HC A02/MF A01

The flip-flop nozzle is a device that can produce an oscillating jet flow without any moving parts. There is now a renewed interest in such nozzles due to their potential for use as excitation devices in practical applications. An experiment aimed at developing twin flip-flop jets that operate at prescribed frequencies and phase differences was performed. The phasing was achieved using two different nozzle interconnection schemes. In one configuration the two jets flapped in-phase and in another they flapped out-of-phase with respect to each other. In either configuration the frequencies of oscillation of both jets were equal. When one of the jets was

run at a constant high velocity and the velocity of the second jet was increased gradually, the higher velocity jet determined the frequency of oscillation of both jets. The two flip-flop jet configurations described could be used to excite a primary jet flow in either an anti-symmetric (sinuous) or a symmetric (varicose) mode. Author (revised)

**N94-21054\*#** Old Dominion Univ., Norfolk, VA. Dept. of Aerospace Engineering.

### **PREDICTION AND CONTROL OF VORTEX-DOMINATED AND VORTEX-WAKE FLOWS Progress Report, 1 Dec. 1992 - 30 Nov. 1993**

OSAMA KANDIL Dec. 1993 123 p

(Contract NAG1-994)

(NASA-CR-194722; NAS 1.26:194722) Avail: CASI HC A06/MF A02

This progress report documents the accomplishments achieved in the period from December 1, 1992 until November 30, 1993. These accomplishments include publications, national and international presentations, NASA presentations, and the research group supported under this grant. Topics covered by documents incorporated into this progress report include: active control of asymmetric conical flow using spinning and rotary oscillation; supersonic vortex breakdown over a delta wing in transonic flow; shock-vortex interaction over a 65-degree delta wing in transonic flow; three dimensional supersonic vortex breakdown; numerical simulation and physical aspects of supersonic vortex breakdown; and prediction of asymmetric vortical flows around slender bodies using Navier-Stokes equations. CASI

**N94-21411#** Stanford Univ., CA. Dept. of Aeronautics and Astronautics.

### **AN EFFICIENT NUMERICAL METHOD FOR THREE-DIMENSIONAL HYPERSONIC FLOW Final Report, 15 Jan. 1987 - 15 Nov. 1992**

ROBERT W. MACCORMACK Feb. 1993 40 p

(Contract F33615-86-C-3015; AF PROJ. 2307)

(AD-A272506; WL-TR-93-3012) Avail: CASI HC A03/MF A01

The present paper presents an efficient algorithm for solving the unsteady Navier-Stokes equations. It is a line Gauss-Seidel relaxation implicit algorithm for three-dimensional flow. Such algorithms have shown very fast convergence properties for two-dimensional flow. The extension to three-dimensions has been troublesome. The proposed algorithm presented herein was developed to solve these difficulties. A computer program based upon this algorithm has been written to solve two-dimensional plane symmetric, axisymmetric or three-dimensional flow of a perfect gas, or a real gas model for air with five species (N<sub>2</sub>, O<sub>2</sub>, NO, N, O) or seven species (N<sub>2</sub>, O<sub>2</sub>, NO, NO+, N, O, e-). The program can simulate a gas in thermal equilibrium or in thermal nonequilibrium with two temperatures (Translational-Rotational and Vibrational) or three temperatures (Translational, Rotational, and Vibrational). Convergence to engineering accuracy is generally achieved in under a hundred time steps for both two- and three-dimensional flow. Provision is made within the program for a one or two equation turbulence model. Applications are presented to verify the code by comparison with experiment and flight tests. Finally, the numerically simulated flow about a hypersonic vehicle at Mach 25 in powered flight is presented. DTIC

**N94-21472\*#** National Technical Univ., Athens (Greece).

### **THE BLOCK ADAPTIVE MULTIGRID METHOD APPLIED TO THE SOLUTION OF THE EULER EQUATIONS**

NIKOS PANTELIS /in NASA. Langley Research Center, The Sixth Copper Mountain Conference on Multigrid Methods, Part 2 p 465-479 Nov. 1993

(Contract AERO-0018C)

Avail: CASI HC A03/MF A03

In the present study, a scheme capable of solving very fast and robust complex nonlinear systems of equations is presented. The Block Adaptive Multigrid (BAM) solution method offers multigrid acceleration and adaptive grid refinement based on the prediction of the solution error. The proposed solution method was used

with an implicit upwind Euler solver for the solution of complex transonic flows around airfoils. Very fast results were obtained (18-fold acceleration of the solution) using one fourth of the volumes of a global grid with the same solution accuracy for two test cases. Author

**N94-21473\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**MULTIGRID SCHEMES FOR VISCOUS HYPERSONIC FLOWS**

R. C. SWANSON and R. RADESPIEL (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany.) In its The Sixth Copper Mountain Conference on Multigrid Methods, Part 2 p 481-495 Nov. 1993  
 Avail: CASI HC A03/MF A03

Several multigrid schemes are considered for the numerical computation of viscous hypersonic flows. For each scheme, the basic solution algorithm employs upwind spatial discretization with explicit multistage time stepping. Two-level versions of the various multigrid algorithms are applied to the two-dimensional advection equation, and Fourier analysis is used to determine their damping properties. The capabilities of the multigrid methods are assessed by solving two different hypersonic flow problems. Some new multigrid schemes, based on semicoarsening strategies, are shown to be quite effective in relieving the stiffness caused by the high-aspect-ratio cells required to resolve high Reynolds number flows. These schemes exhibit good convergence rates for Reynolds numbers up to  $200 \times 10$  (exp 6). Author

**N94-21569\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**INTERNAL PERFORMANCE OF A NONAXISYMMETRIC NOZZLE WITH A ROTATING UPPER FLAP AND A CENTER-PIVOTED LOWER FLAP**

DAVID J. WING, LAURENCE D. LEAVITT, and RICHARD J. RE Nov. 1993 59 p  
 (Contract RTOP 505-62-30-01)  
 (NASA-TP-3385; L-17235; NAS 1.60:3385) Avail: CASI HC A04/MF A01

An investigation was conducted at wind-off conditions in the static-test facility of the Langley 16-Foot Transonic Tunnel to determine the internal performance characteristics of a single expansion-ramp nozzle with thrust-vectoring capability to 105 degrees. Thrust vectoring was accomplished by the downward rotation of an upper flap with adaptive capability for internal contouring and a corresponding rotation of a center-pivoted lower flap. The static internal performance of configurations with pitch thrust-vector angles of 0 degrees, 60 degrees, and 105 degrees each with two throat areas, was investigated. The nozzle pressure ratio was varied from 1.5 to approximately 8.0 (5.0 for the maximum throat area configurations). Results of this study indicated that the nozzle configuration of the present investigation, when vectored, provided excellent flow-turning capability with relatively high levels of internal performance. In all cases, the thrust vector angle was a function of the nozzle pressure ratio. This result is expected because the flow is bounded by a single expansion surface on both vectored- and unvectored-nozzle geometries. Author

**N94-21591\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**A STUDY OF THE COMPRESSIBLE FLOW THROUGH A DIFFUSING S-DUCT**

STEVEN R. WELLBORN (Iowa State Univ. of Science and Technology, Ames.), THEODORE H. OKIISHI (Iowa State Univ. of Science and Technology, Ames.), and BRUCE A. REICHERT Dec. 1993 108 p Sponsored by NASA. Washington  
 (Contract RTOP 505-62-52)  
 (NASA-TM-106411; E-8247; NAS 1.15:106411) Avail: CASI HC A06/MF A02

Benchmark aerodynamic data are presented for compressible flow through a representative S-duct configuration. A numerical prediction of the S-duct flow field, obtained from a subsonic parabolized Navier-Stokes algorithm, is also shown. The

experimental and numerical results are compared. Measurements of the three-dimensional velocity field, total pressures, and static pressures were obtained at five cross-sectional planes. Aerodynamic data were gathered with calibrated pneumatic probes. Surface static pressure and surface flow visualization data were also acquired. All reported tests were conducted with an inlet centerline Mach number of 0.6. The Reynolds number, based on the inlet centerline velocity and duct inlet diameter, was  $2.6 \times 10$  (exp 6). Thin inlet turbulent boundary layers existed. The collected data should be beneficial to aircraft inlet designers and the measurements are suitable for the validation of computational codes. The results show that a region of streamwise flow separation occurred within the duct. Details about the separated flow region, including mechanisms which drive this complicated flow phenomenon, are discussed. Results also indicate that the duct curvature induces strong pressure driven secondary flows. The cross flows evolve into counter-rotating vortices. These vortices convect low momentum fluid of the boundary layer toward the center of the duct, degrading both the uniformity and magnitude of the total pressure profile. Author

**N94-21833\*#** Stanford Univ., CA. Dept. of Aeronautics and Astronautics.

**NONLINEAR AERODYNAMICS AND THE DESIGN OF WING TIPS Final Report, 1 Apr. 1992 - 31 Mar. 1993**

ILAN KROO and SEAN WAKAYAMA Sep. 1993 14 p  
 (Contract NCC2-683)  
 (NASA-CR-194732; NAS 1.26:194732) Avail: CASI HC A03/MF A01

This contract began in April 1990 with studies on the effect of wingtip shape on induced drag. That work considered problems of determining induced drag from computational aerodynamic methods and examined effects of wake roll up on the induced drag of elliptical and crescent wings. The research contract was continued in April 1991 and again in April 1992 with scope augmented to include considerations other than induced drag. The idea was to develop methods for comparing wing tip shapes on the basis of their effects on total drag, structural weight, and high lift performance. To accomplish this, work was done to improve methods for multidisciplinary analysis and optimization of wings. This report describes results of research conducted from April 1992 through March 1993. The general objective was to improve an existing wing optimization method and apply the method to specific problems of interest. The method, while a valuable tool for wing tip design studies, can be applied to more general problems, and has been applied to some of these other problems during its development. Specific goals that were accomplished are listed below and are explained in more detail in attached reports: analysis methods were improved in the area of structural modeling; small improvements to the high lift model were made, and ideas were collected on how clean wing  $c_{(sub\ l(sub\ max))}$  should vary with sweep - these ideas should provide a guide for future examination of high lift with experiment or CFD; and a calculation for drag due to the loss of leading edge suction was added to the wing analysis. Derived from text

**N94-22260#** Technische Univ., Delft (Netherlands). Inst. for Wind Energy.

**NEAR WAKE MEASUREMENTS ON A ROTOR MODEL WITH MIE-VANES IN THE DELFT OPEN JET TUNNEL**

H. IMAMURA and N. J. VERMEER Aug. 1992 33 p See also PB92-202845 Prepared in cooperation with Mie Univ.  
 (PB93-215382; IW-92052R) Avail: CASI HC A03/MF A01

As a part of the international collaboration between Mie University and Delft University of Technology, near wake measurements behind a rotor model with Mie-vanes have been performed in the Delft open jet wind tunnel. Preceding these measurements, the performance measurements of this rotor model with Mie-vanes have already been carried out in Delft. In these measurements, the augmentation of rotor output power by application of Mie-vanes was not obtained. This can partly be contributed to higher optimal tip speed ratio of the Delft rotor model. NTIS

**N94-22274\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

### **INSTABILITY MODES EXCITED BY NATURAL SCREECH TONES IN A SUPERSONIC RECTANGULAR JET**

GANESH RAMAN (Sverdrup Technology, Inc., Brook Park, OH.) and EDWARD J. RICE Dec. 1993 18 p Presented at the 15th AIAA Aeroacoustics Conference, Long Beach, CA, 25-27 Oct. 1993; sponsored by AIAA

(Contract RTOP 505-62-52)

(NASA-TM-106409; E-8246; NAS 1.15:106409; AIAA PAPER 93-4321) Avail: CASI HC A03/MF A01

The evolution of hydrodynamic instability modes self-excited by harmonically related natural screech tones was experimentally investigated. A convergent rectangular nozzle with an aspect ratio of 9.63 was used to produce a supersonic shock containing jet. Measurements in the flow-field were made using standard hot-film probes positioned only in the subsonic (outer) portions of the flow. The hydrodynamic instability mode observed in the shear layer at the screech frequency was observed to be antisymmetric (sinuous) about the smaller dimension of the jet, whereas its harmonic was observed to be symmetric (varicose). In addition, the near-field noise measurements indicated that the radiated screech tone noise was out of phase on either side of the small jet dimension whereas its harmonic was in phase over the same region. To our knowledge such an observation on the nature of the harmonic has thus far gone unreported and therefore is the focus of the present work. The hydrodynamic instability modes occurring at the screech frequency and its harmonic satisfied the conditions for resonance. Detailed measurements of the coherent wave evolution in the streamwise and spanwise directions indicated that strong spanwise variations were present beyond  $x/h = 8$ . Details of the screech noise radiated by the coherent instability modes are also presented in this paper. Author (revised)

**N94-22382** British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.

### **MODELLING STALLED AIRFOILS Ph.D. Thesis**

WILLIAM WAIHUNG YEUNG Apr. 1990 166 p (ISBN-0-315-59525-6; CTN-94-60891) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

New applications of the wake source model, a two-dimensional incompressible potential flow model used for bodies experiencing flow separation, are presented. The body contour is conformally mapped to a circle, for which the problem is solved using source singularities to create free streamlines simulating the separating shear layers. In common with other inviscid theories, it generally requires the pressure in the separated flow region, and the location of separation if boundary layer controlled. Different mapping sequences and flow models have been constructed for the cases of trailing-edge stall for single element airfoils, flat plates with separation bubbles, separation bubbles upstream of spoilers with downstream wakes, spoiler/slotted flap combinations at which the spoiler inclination is arbitrary, and two-element airfoils near stall. Predictions of pressure distribution are compared with wind tunnel measurements, good agreement is found in the 1st and 5th cases, and results in the 2nd and 3rd cases are promising. Partial success was achieved for the 4th case, depending on spoiler inclination; the discrepancy diminishes as the spoiler angle decreases in the cases of higher incidences so that the wake boundary tugs away from the flap sooner. Author (CISTI)

**N94-22586** Toronto Univ. (Ontario). Dept. of Aerospace Science and Engineering.

### **TRANSONIC FLOW CALCULATIONS: INTEGRAL METHOD**

#### **M.S. Thesis**

MARC LANGLOIS 1993 110 p (ISBN-0-315-83538-9; CTN-94-60948) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

An integral equation (IE, or field panel) method has been developed to predict potential transonic flows around two-dimensional configurations, using the panel method approach.

Compressibility is taken into account by a distribution of sources in the field. Shock waves are captured using type-dependent differencing in the evaluation of the field sources. Since no inflow or outflow boundary conditions need to be imposed and the sources' strength declines rapidly away from the airfoil(s), only a small computational domain is necessary. The method also has the advantage in that the field grid does not need to be body conforming, allowing use of a Cartesian mesh. The code was evaluated for subcritical and supercritical flows on the NACA 0012, NACA 64A010, RAE 2822, and Williams B airfoils. Subcritical results were found to be in very good agreement with other data from IE methods, although comparison with finite difference (FD) data shows a tendency to underpredict lift considerably. In comparison with FD transonic results, the location of shocks was predicted well, but these usually are weaker and more spread. Agreement with other IE methods for transonic flows is also very good.

Author (CISTI)

**N94-22597#** Technische Univ., Berlin (Germany). Inst. fuer Luft- und Raumfahrt.

### **MEASUREMENT TECHNOLOGY FOR FLIGHT TESTS**

#### **[MESSTECHNIK FUER FLUGVERSUCHE]**

W. NITSCHKE, ed. and J. SZODRUCH, ed. May 1991 133 p In ENGLISH and GERMAN Presented at DGLR-Fachausschusstagung, Hamburg, Germany, 30-31 Jan. 1991 Original contains color illustrations (ILR-MITT-256(1991); ETN-94-95076) Avail: CASI HC A07/MF A02

In the framework of a German research program on fluid dynamics and thermodynamics tests, methodologies for flight tests are presented. The following topics were included: surface hot film measurements of ATTAS research aircraft laminar glove; testing of a multisensor hot film technique in wind channels and free flight; free flight experiments with a laminar wing glove; experiments with a fluid deicing system for cleaning laminar wings; measurement of the influence of deicing liquids on aircraft aerodynamics; implementation of lasers for air data measurements; hot wire anemometry—a versatile instrumentation used for predevelopment studies and flight testing of the Do-328 aircraft; riblet boundary layer measurements of an A320 aircraft fuselage with Pitot rakes; and image processing as a tool in flight testing evaluation and contributions to the development of flight test measurement techniques.

ESA

**N94-22599#** Technische Hochschule, Aachen (Germany). Aerodynamisches Inst.

### **TESTING OF A MULTISENSOR HOT FILM TECHNIQUE IN WIND TUNNEL AND FREE FLIGHT [ERPROBUNG EINER NEUENTWICKELTEN MULTISENSOR-HEISSFILMTECHNIK IM WINDKANAL UND FREIFLUG]**

M. KORNBERGER and F. FEYZI In Tech. Univ. Berlin, Measurement Technology for Flight Tests p 12-20 May 1991 In GERMAN

Avail: CASI HC A02/MF A02

A multisensor hot film measurement technique, which allows ninety-six sensors to be simultaneously operated on a polyimide foil and was used in free flight tests of laminar gloves, is described. The technique was also used for transition estimation in a low speed wind tunnel; angle of incidence and flow velocity were chosen as the experiment parameters. Each hot film was calibrated with a comparative measuring process for estimation of magnitude and direction of wall shear stress vector. The results were transferred to the multisensor technique as far as possible. Another calibration method, which is based on the solution of heat transfer balance equations for a hot film, was developed in order to take into account heat conduction, which was calculated for a rotation symmetric body. ESA

**N94-22600#** Technische Univ., Berlin (Germany). Inst. fuer Luft- und Raumfahrt.

**FREE FLIGHT EXPERIMENT WITH A LAMINAR WING GLOVE [FREIFLUGEXPERIMENTE MIT EINEM LAMINARFLUEGEL-HANDSCHUH]**

N. WEISER and W. NITSCHKE *In its* Measurement Technology for Flight Tests p 21-34 May 1991 In GERMAN  
Avail: CASI HC A03/MF A02

The CPM3 (Computational Preston Tube) method and the piezo array technique are compared in terms of functionality for laminar turbulent boundary layer transition investigations. The CPM3 technique is based on static pressure measurement from three wall Pitot probes of differential pressure sensors; the local wall shear stress is obtained from measured velocities in correlation with the effective wall distance by adaptation of the proportionality factor between mixture length and wall distance. Piezoelectric foils are used in multisensor arrays as electromagnetic converters for detection of wall pressure oscillations. Because of their high sensitivity and flexibility, they are particularly suited to examination of unstationary wall forces and can be mounted on an airfoil surface without perturbation. Wind tunnel measurements were carried out in order to establish static pressure probe reliability. Results of wall friction distributions with different angles of incidence are presented and compared with data calculated using the Eppler code. ESA

**N94-22602#** Deutsche Lufthansa A.G., Hamburg (Germany).  
**MEASUREMENT OF THE INFLUENCE OF DEICING LIQUIDS ON AIRCRAFT AERODYNAMICS [DIE MESSUNG DES EINFLUSSES VON ENTEISUNGSFLUESSIGKEITEN AUF DIE AERODYNAMIK DES FLUGZEUGES]**

U. RUMMELMANN *In Tech. Univ. Berlin, Measurement Technology for Flight Tests* p 57-63 May 1991 In GERMAN  
Avail: CASI HC A02/MF A02

Flight tests were carried out in the all engine operating case in order to determine the influence of four different deicing liquids on Boeing 737-200 aerodynamics. Two different slat/flap positions were considered in this investigation. For local film thickness a measuring process was developed. The process was based on laser sensors. The data were enhanced by video, photography, and movie recordings. The role of liquid density and temperature was examined. Drag resistance and lift variations were obtained using a high velocity PCM (Pulse Code Modulation) data acquisition facility; this system was used as the data source for the airborne data analysis and monitoring system, which allows data quality to be evaluated. The following data were obtained and studied: static and dynamic pressures, wind velocity and direction, ground proximity data, and trim angle of the tailplane. ESA

**N94-22605#** Deutsche Airbus G.m.b.H., Bremen (Germany).  
**RIBLET BOUNDARY LAYER MEASUREMENTS OF AN A-310 FUSELAGE WITH PITOT COMBS [RIBLET-GRENZSCHICHTMESSUNGEN AN EINEM A320-RUMPF MIT PITOT - RECHEN]**

F. X. MUENCH and R. HENKE *In Tech. Univ. Berlin, Measurement Technology for Flight Tests* p 97-110 May 1991 In GERMAN  
Avail: CASI HC A03/MF A02

Preparation, running, and results of global measurements for a flight test of riblet effects with the A-320 aircraft are presented. The following activities are reported: three dimensional boundary layer calculation for estimation of wall stream line direction, wall shear stress distribution and boundary layer thickness, choice of riblet location on the aircraft, and preparation of the local measurements of velocity profiles at some chosen parts of the aircraft. For the boundary layer measurements, two Pitot combs were mounted one behind the other on the fuselage upper side. Pressure values, Mach number, calibrated flight velocity, altitude, lift coefficient, angles of attack, and sideslip and vertical and lateral accelerations were recorded on magnetic tape. The method is found to be reproducible, insensitive to aircraft vibrations and useful for obtaining information about riblet effects. ESA

**N94-22607#** Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

**RECENT ONERA CONTRIBUTIONS TO THE DEVELOPMENT OF FLIGHT TEST MEASUREMENT TECHNIQUES**

V. SCHMITT, D. ARNAL (Centre d'Etudes et de Recherches, Toulouse, France.), and J. J. THIBERT *In Tech. Univ. Berlin, Measurement Technology for Flight Tests* p 118-129 May 1991  
Avail: CASI HC A03/MF A02

Activities in flight testing are summarized with an emphasis on particular requirements and specifications to achieve the required quality of the results. Some examples for both surface measurements and flow field measurement techniques are given. They were related to a variety of topics such as high lift investigations, transonic drag rise evaluation, riblet effects on boundary layers or wakes, and laminar flow research. These examples show that there is an increasing need for flow investigations in flight tests to validate wind tunnel or computer simulations. ESA

## 03

## AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

**N94-20912** Rendzio (Robert J.), Ozark, AL.

**ARMY AIRCRAFT FIRE-DETECTION SYSTEMS OPERATION AND RELIABILITY Final Report, Oct. 1988 - Sep. 1992**

ROBERT J. RENDZIO, KARLA FLAHERTY, ed., and FRANK SISK 5 Oct. 1993 21 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A271327) Avail: CASI HC A03

This report evaluates the results of a five year study of fire indications onboard army aircraft. Specifically it evaluates the aircraft fire detection systems. The overall conclusion drawn from the report is that the fire detection systems are unreliable and do not meet the intent of the applicable specifications governing such devices. DTIC

**N94-21030** Honeywell, Inc., Phoenix, AZ.

**WINDSHEAR DETECTION FOR AIRCRAFT USING TEMPERATURE LAPSE RATE Patent**

TERRY L. ZWEIFEL, inventor (to Honeywell, Inc.) 11 Feb. 1992 44 p Filed 2 Nov. 1988 (CA-PATENT-1,295,736; INT-PATENT-CLASS-G08B-31/00; CTN-93-60639) Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC/MF

An on-board aircraft system is described that provides an indication of wind shear probability considerably before prior art systems. A measurement of temperature change with altitude (temperature lapse rate) is made, filtered to eliminate noise, and compared to the dry adiabatic temperature lapse rate: the latter being indicative of unstable air. When the measured or empirical temperature lapse rate is less than the dry adiabatic temperature lapse rate for a predetermined number of measurements, a cautionary message is relayed to the flight crew with a caution light. The same cautionary message may be transmitted to the landing airport to be used to caution other aircraft and may also be used to enhance the detection capability of existing on-board prior art systems. If a cautionary message has been generated and the aircraft enters a region of rapidly decreasing temperature as is usually present in the downflow of a microburst, a warning message is generated alerting the flight crew to take immediate action to exit the condition. The warning message may also be transmitted to the landing airport and used to warn other aircraft and/or used to enhance the detection capability of existing on-board prior art systems. Author (CISTI)



### 03 AIR TRANSPORTATION AND SAFETY

**N94-21428** Illinois Univ., Urbana-Champaign. Dept. of Community Health.

**AVIATION SAFETY RESEARCH. VOLUME 1: LITERATURE REVIEW OF SOURCES OF AVIATION ACCIDENT AND INCIDENT DATA AND SELECTED FACTORS CONTRIBUTING TO ACCIDENTS**

R. G. MORTIMER and J. S. HANSON 7 May 1993 216 p  
Sponsored by Construction Engineering Research Lab. (Army), Champaign, IL Limited Reproducibility: More than 20% of this document may be affected by microfiche quality  
(Contract DACA88-90-D-0028-28)  
(PB93-202885; SAFETY RESEARCH-93-1-VOL-1) Avail: CASI HC A10

The report is Volume 1 in studies of aviation accidents. The emphasis is on general aviation, but Part 135 and 121 operations are also discussed. It is a review of the literature of sources of aviation accident and exposure data and of selected factors affecting safety in aviation. Among topics covered are: epidemiological studies, weather factors, induced pilot error, and the stall accident. It is believed that improved aerodynamic design, using available knowledge, could reduce stall/spin accidents by 10%. Weather is a primary cause in about 18% of all accidents and in 32% of fatal accidents, and is a major contributor to accidents of general and commercial aviation. Alcohol is now involved in about 5% of pilots who are fatally injured, but about 12% have used therapeutic drugs and 3% illicit drugs. NTIS

**N94-21590\*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**USERS MANUAL FOR THE NASA LEWIS**

**THREE-DIMENSIONAL ICE ACCRETION CODE (LEWICE 3D)**  
COLIN S. BIDWELL and MARK G. POTAPCZUK Dec. 1993  
143 p Sponsored by NASA. Washington  
(Contract RTOP 505-68-10)  
(NASA-TM-105974; E-7847; NAS 1.15:105974) Avail: CASI HC A07/MF A02

A description of the methodology, the algorithms, and the input and output data along with an example case for the NASA Lewis 3D ice accretion code (LEWICE3D) has been produced. The manual has been designed to help the user understand the capabilities, the methodologies, and the use of the code. The LEWICE3D code is a conglomeration of several codes for the purpose of calculating ice shapes on three-dimensional external surfaces. A three-dimensional external flow panel code is incorporated which has the capability of calculating flow about arbitrary 3D lifting and nonlifting bodies with external flow. A fourth order Runge-Kutta integration scheme is used to calculate arbitrary streamlines. An Adams type predictor-corrector trajectory integration scheme has been included to calculate arbitrary trajectories. Schemes for calculating tangent trajectories, collection efficiencies, and concentration factors for arbitrary regions of interest for single droplets or droplet distributions have been incorporated. A LEWICE 2D based heat transfer algorithm can be used to calculate ice accretions along surface streamlines. A geometry modification scheme is incorporated which calculates the new geometry based on the ice accretions generated at each section of interest. The three-dimensional ice accretion calculation is based on the LEWICE 2D calculation. Both codes calculate the flow, pressure distribution, and collection efficiency distribution along surface streamlines. For both codes the heat transfer calculation is divided into two regions, one above the stagnation point and one below the stagnation point, and solved for each region assuming a flat plate with pressure distribution. Water is assumed to follow the surface streamlines, hence starting at the stagnation zone any water that is not frozen out at a control volume is assumed to run back into the next control volume. After the amount of frozen water at each control volume has been calculated the geometry is modified by adding the ice at each control volume in the surface normal direction.

Author (revised)

**N94-21818\*** Boeing Commercial Airplane Co., Seattle, WA. Payload Systems.

**AIRCRAFT CABIN WATER SPRAY DISBENEFITS STUDY Final Report**

THOMAS L. REYNOLDS and KENT W. PORTER Oct. 1993  
137 p Sponsored in part by FAA  
(Contract NAS1-18027)  
(NASA-CR-194750; NAS 1.26:194750; DOT/FAA/CT-92/6)  
Avail: CASI HC A07/MF A02

The concept of utilizing a cabin water spray system (CWSS) as a means of increasing passenger evacuation and survival time following an accident has received considerable publicity and has been the subject of testing by the regulatory agencies in both the United States and Europe. A test program, initiated by the CAA in 1987, involved the regulatory bodies in both Europe and North America in a collaborative research effort to determine the benefits and 'disbenefits' (disadvantages) of a CWSS. In order to obtain a balanced opinion of an onboard CWSS, NASA, and FAA requested the Boeing Commercial Airplane Group to investigate the potential 'disbenefits' of the proposed system from the perspective of the manufacturer and an operator. This report is the result of a year-long, cost-sharing contract study between the Boeing Commercial Airplane Group, NASA, and FAA. Delta Air Lines participated as a subcontract study team member and investigated the 'return to service' costs for an aircraft that would experience an uncommanded operation of a CWSS without the presence of fire. Disbenefits identified include potential delays in evacuation, introduction of 'common cause failure' in redundant safety of flight systems, physiological problems for passengers, high cost of refurbishment for inadvertent discharge, and potential to negatively affect other safety systems. Author (revised)

**N94-22055** Transportation Research Board, Washington, DC.  
**PUBLIC-SECTOR AVIATION ISSUES: GRADUATE RESEARCH AWARD PAPERS, 1991-1992**

N. C. KASSABIAN, A. G. TOBIAS, L. CRAYTON, N. SOLOMON, and S. E. G. BROWN 1993 50 p See also PB92-222629  
Limited Reproducibility: More than 20% of this document may be affected by microfiche quality  
(PB93-206258; TRB/TRR-1379.) Avail: CASI HC A03

Contents of the document are: robust control techniques for a commercial autoland system; response of U.S. air carriers to on-time disclosure rule; policy-level decision support for airport passenger terminal design; reexamination of stall and spin prevention training; and development of risk models for simultaneous instrument landing system approaches to closely spaced parallel runways. NTIS

**N94-22373\*** Miami Univ., Coral Gables, FL. Dept. of Management Science.

**INTERVENTION STRATEGIES FOR THE MANAGEMENT OF HUMAN ERROR**

EARL L. WIENER Aug. 1993 114 p  
(Contract NCA2-441)  
(NASA-CR-4547; A-93120; NAS 1.26:4547) Avail: CASI HC A06/MF A02

This report examines the management of human error in the cockpit. The principles probably apply as well to other applications in the aviation realm (e.g. air traffic control, dispatch, weather, etc.) as well as other high-risk systems outside of aviation (e.g. shipping, high-technology medical procedures, military operations, nuclear power production). Management of human error is distinguished from error prevention. It is a more encompassing term, which includes not only the prevention of error, but also a means of disallowing an error, once made, from adversely affecting system output. Such techniques include: traditional human factors engineering, improvement of feedback and feedforward of information from system to crew, 'error-evident' displays which make erroneous input more obvious to the crew, trapping of errors within a system, goal-sharing between humans and machines (also called 'intent-driven' systems), paperwork management, and behaviorally based approaches, including procedures, standardization, checklist design, training, cockpit resource

management, etc. Fifteen guidelines for the design and implementation of intervention strategies are included.

Author (revised)

## 04

## AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

**N94-21606\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**DEVELOPMENT AND EVALUATION OF A PROFILE NEGOTIATION PROCESS FOR INTEGRATING AIRCRAFT AND AIR TRAFFIC CONTROL AUTOMATION**

STEVEN M. GREEN, WIM DENBRAVEN (National Aerospace Lab., Amsterdam, Netherlands.), and DAVID H. WILLIAMS (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) Apr. 1993 23 p Presented at the RTCA 1991 Annual Assembly Meeting and Technical Symposium (Contract RTOP 505-64-13)

(NASA-TM-4360; A-92038; NAS 1.15:4360) Avail: CASI HC A03/MF A01

The development and evaluation of the profile negotiation process (PNP), an interactive process between an aircraft and air traffic control (ATC) that integrates airborne and ground-based automation capabilities to determine conflict-free trajectories that are as close to an aircraft's preference as possible, are described. The PNP was evaluated in a real-time simulation experiment conducted jointly by NASA's Ames and Langley Research Centers. The Ames Center/TRACON Automation System (CTAS) was used to support the ATC environment, and the Langley Transport Systems Research Vehicle (TSRV) piloted cab was used to simulate a 4D Flight Management System (FMS) capable aircraft. Both systems were connected in real time by way of voice and data lines; digital datalink communications capability was developed and evaluated as a means of supporting the air/ground exchange of trajectory data. The controllers were able to consistently and effectively negotiate nominally conflict-free vertical profiles with the 4D-equipped aircraft. The actual profiles flown were substantially closer to the aircraft's preference than would have been possible without the PNP. However, there was a strong consensus among the pilots and controllers that the level of automation of the PNP should be increased to make the process more transparent. The experiment demonstrated the importance of an aircraft's ability to accurately execute a negotiated profile as well as the need for digital datalink to support advanced air/ground data communications. The concept of trajectory space is proposed as a comprehensive approach for coupling the processes of trajectory planning and tracking to allow maximum pilot discretion in meeting ATC constraints. Author (revised)

**N94-21629\*#** Lockheed Engineering and Sciences Co., Hampton, VA.

**TECHNIQUES USED FOR THE ANALYSIS OF OCULOMETER EYE-SCANNING DATA OBTAINED FROM AN AIR TRAFFIC CONTROL DISPLAY**

DANIEL J. CRAWFORD, DANIEL W. BURDETTE, and WILLIAM R. CAPRON Dec. 1993 184 p

(Contract NAS1-19000; RTOP 505-64-13-01)

(NASA-CR-191559; NAS 1.26:191559) Avail: CASI HC A09/MF A02

The methodology and techniques used to collect and analyze look-point position data from a real-time ATC display-format comparison experiment are documented. That study compared the delivery precision and controller workload of three final approach spacing aid display formats. Using an oculometer, controller lookpoint position data were collected, associated with gaze objects (e.g., moving aircraft) on the ATC display, and analyzed to

determine eye-scan behavior. The equipment involved and algorithms for saving, synchronizing with the ATC simulation output, and filtering the data are described. Target (gaze object) and cross-check scanning identification algorithms are also presented. Data tables are provided of total dwell times, average dwell times, and cross-check scans. Flow charts, block diagrams, file record descriptors, and source code are included. The techniques and data presented are intended to benefit researchers in other studies that incorporate non-stationary gaze objects and oculometer equipment. Author (revised)

**N94-22134** Allied-Signal Aerospace Canada, Toronto (Ontario).

**MLS SIGNAL-IN-SPACE CATEGORY 3 LANDING HAZARD ANALYSIS**

R. J. KELLY In Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 4 p 1991

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

The risks associated with a microwave landing system (MLS) signal-in-space and the information displayed to the pilot during approach and landing are large statistical guidance errors, loss of guidance information, and loss of signal integrity. MLS equipment specifications quantify these risks. An analysis is presented to identify the elements in the risk allocation process which formed the basis of MLS Category III specifications. Use of a hazard tree process uncovers the interrelationship between accuracy, continuity of service, and integrity in a way that shows the internal consistency of the MLS system design. The objective of this work is to develop a systems engineering methodology which identifies all the important factors contributing to an accident. As the analysis assumptions are confirmed by operational experience, the risk allocation tree can be updated and refined. Author (CISTI)

**N94-22135** Transport Canada, Ottawa (Ontario).

**APPLICATION OF SCATTERING BY ARRAYS OF CYLINDERS TO MLS SIGNAL PROPAGATION ERROR ESTIMATION**

M. Z. EL-GAMAL and DO-DUY HUNG In Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 5 p 1991

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

Microwave landing systems (MLS) are collocated with approach light systems (ALS) and with existing instrument landing systems (ILS). Signals radiated from MLS are subject to unwanted reflections and shadowing from the ALS and ILS structures, as well as from the runway hump when it exists. The boundary discrete points method (BDP), originally developed to study the scattering of electromagnetic waves by multiple cylinders of different types, is applied to analyze the MLS signal scattering problem. The ILS localizer and ALS structures are represented by a number of cylinders or a combination of cylinders and spheres. A FORTRAN computer program was used to calculate scattered field. Initial results indicate that BDP is a simple but accurate technique that can be easily utilized to estimate the angle guidance error, path following error, control motion noise, and the power densities of signals from MLS antennas along the approach path of an aircraft and during the rollout for the humped-runway situation. Author (CISTI)

**N94-22136** Republic Electronic Industries Corp., Melville, NY.

**TESTING OF DME/P EQUIPMENT PERFORMANCE FOR COMPLEX MLS PROCEDURES**

J. F. MICHAELS In Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 4 p 1991

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

The performance of airborne distance measuring equipment needs to be tested and maintained to ensure that it can operate in its intended mode in a microwave landing system. The capabilities of the test and simulation equipment developed by Republic Electronics are described. The equipment comprises a

microprocessor based system that can be used to test the airborne distance measuring equipment interrogation in a shop environment and in both the initial approach and final approach modes of operation. Distance information displayed on a separate display terminal is used to produce path following error and control motion noise calculations. Operator programmable parameters include range, range rate, range acceleration, overflight, radio frequency level, pulse spacing, reply efficiency, and echo. Calculations may also be performed to determine if the equipment is operating within the specified tolerances. Author (CISTI)

**N94-22154** Micronav Ltd., Sydney (Nova Scotia).

### **MLS POINTING ANGLE ERROR SOURCES AND EFFECTS**

DAVID BABINEAU, MIKE MCALONEY, and MAURICE MEYER /n Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 4 p 1991

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

Angle guidance for aircraft is one of the important functions performed by a microwave landing system. Identification of error sources is required by manufacturers of such systems in order to manage equipment error budgets. An analysis is presented of error sources internal to the angle guidance ground equipment which affect the angle accuracy measured at the aircraft. A straightforward approach for estimating the end effect for some of the error sources is given. The antenna components of the phased arrays typically used in microwave landing systems are divided into three types for the analysis: power divider, phase shifter, and waveguide. Error effects are divided into two categories: amplitude errors and phase errors. Other error sources discussed are those resulting from beam steering and from waveguide/frame parameters. The approach presented is a tool for reasonability checking and for initial design trade studies. Author (CISTI)

**N94-22155** Micronav Ltd., Sydney (Nova Scotia).

### **DEVELOPING SOFTWARE TO RTCA DO-178A**

ROSS HOOPER, JOHN LORD, and KATHY MACINTYRE /n Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 3 p 1991

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

Software experiences during two development cycles of a microwave landing system (MLS) at Micronav International are presented. The MLS software was developed to Radio Technical Commission for Aeronautics standard/guideline DO-178A. The experiences and lessons which are described were learned over a three-year period where the software development methods were defined and formalized. Micronav's interpretation of the DO-178A phases of development and their impact are discussed. Particular emphasis is placed on the understanding of requirements definition, high level design, and verification and validation. Author (CISTI)

**N94-22156** Ohio Univ., Athens.

### **A FLIGHT TEST SYSTEM DESIGN FOR THE MICROWAVE LANDING SYSTEM**

D. B. VICKERS /n Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 4 p 1991

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

The technical design of an aircraft true position (tracking) and data collection system to support flight tests of a microwave landing system (MLS) is reviewed. Key MLS characteristics and aircraft dynamics are analyzed in order to specify the minimum sampling rates for MLS and aircraft position data, the maximum allowable aircraft true position error in various regions of the MLS coverage volume, and the transformations and translations needed to achieve coincidence between MLS and true position coordinate systems. Existing and possible future implementations for determining the aircraft true position are discussed. Author (CISTI)

**N94-22219** Laval Univ. (Quebec). Dept. de Genie Electrique.

### **FM INTERFERENCE IN RADIO NAVIGATION RECEIVERS [INTERFERENCE MF DANS LES RECEPTEURS DE RADIO NAVIGATION]**

H. T. HUYNH, J. M. VEZIN, and D. ANGERS /n Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 4 p 1991 In FRENCH

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

The azimuthal location receiver in an instrument landing system uses the 108-118 MHz frequency band which is adjacent to the FM broadcast band. With its low power (10 watts), the receiver would be strongly affected by the interference from the FM intermodulation provoked by two or three FM broadcast signals (interferences of type B1). Using a standard receiver with automatic gain control, the interference power/signal power ratio is computed at the interference threshold. The results show that the receiver is perfectly characterized only by its intermediate frequency stage bandwidth. The worst case is noted when the intermodulation signal frequency coincides with the main carrier. The more the frequency difference increases, the more the system becomes tolerant. Author (CISTI)

**N94-22277\*#** Boeing Commercial Airplane Co., Seattle, WA.

### **PARALLEL RUNWAY REQUIREMENT ANALYSIS STUDY.**

#### **VOLUME 1: THE ANALYSIS Final Report**

YAGHOUB S. EBRAHIMI Dec. 1993 129 p

(Contract NAS1-18027; RTOP 505-66-41-04)

(NASA-CR-191549-VOL-1; NAS 1.26:191549-VOL-1) Avail: CASI HC A07/MF A02

The correlation of increased flight delays with the level of aviation activity is well recognized. A main contributor to these flight delays has been the capacity of airports. Though new airport and runway construction would significantly increase airport capacity, few programs of this type are currently underway, let alone planned, because of the high cost associated with such endeavors. Therefore, it is necessary to achieve the most efficient and cost effective use of existing fixed airport resources through better planning and control of traffic flows. In fact, during the past few years the FAA has initiated such an airport capacity program designed to provide additional capacity at existing airports. Some of the improvements that that program has generated thus far have been based on new Air Traffic Control procedures, terminal automation, additional Instrument Landing Systems, improved controller display aids, and improved utilization of multiple runways/Instrument Meteorological Conditions (IMC) approach procedures. A useful element to understanding potential operational capacity enhancements at high demand airports has been the development and use of an analysis tool called The PLAND—BLUNDER (PLB) Simulation Model. The objective for building this simulation was to develop a parametric model that could be used for analysis in determining the minimum safety level of parallel runway operations for various parameters representing the airplane, navigation, surveillance, and ATC system performance. This simulation is useful as: a quick and economical evaluation of existing environments that are experiencing IMC delays, an efficient way to study and validate proposed procedure modifications, an aid in evaluating requirements for new airports or new runways in old airports, a simple, parametric investigation of a wide range of issues and approaches, an ability to tradeoff air and ground technology and procedures contributions, and a way of considering probable blunder mechanisms and range of blunder scenarios. This study describes the steps of building the simulation and considers the input parameters, assumptions and limitations, and available outputs. Validation results and sensitivity analysis are addressed as well as outlining some IMC and Visual Meteorological Conditions (VMC) approaches to parallel runways. Also, present and future applicable technologies (e.g., Digital Autoland Systems, Traffic Collision and Avoidance System II, Enhanced Situational Awareness System, Global Positioning Systems for Landing, etc.) are assessed and recommendations made. Derived from text

**N94-22278\*** Boeing Commercial Airplane Co., Seattle, WA.  
**PARALLEL RUNWAY REQUIREMENT ANALYSIS STUDY.**  
**VOLUME 2: SIMULATION MANUAL Final Report**  
 YAGHOOB S. EBRAHIMI and KEN S. CHUN Dec. 1993 51 p  
 (Contract NAS1-18027; RTOP 505-66-41-04)  
 (NASA-CR-191549-VOL-2; NAS 1.26:191549-VOL-2) Avail: CASI  
 HC A04/MF A01

This document is a user manual for operating the PLAND—BLUNDER (PLB) simulation program. This simulation is based on two aircraft approaching parallel runways independently and using parallel Instrument Landing System (ILS) equipment during Instrument Meteorological Conditions (IMC). If an aircraft should deviate from its assigned localizer course toward the opposite runway, this constitutes a blunder which could endanger the aircraft on the adjacent path. The worst case scenario would be if the blundering aircraft were unable to recover and continue toward the adjacent runway. PLAND—BLUNDER is a Monte Carlo-type simulation which employs the events and aircraft positioning during such a blunder situation. The model simulates two aircraft performing parallel ILS approaches using Instrument Flight Rules (IFR) or visual procedures. PLB uses a simple movement model and control law in three dimensions (X, Y, Z). The parameters of the simulation inputs and outputs are defined in this document along with a sample of the statistical analysis. This document is the second volume of a two volume set. Volume 1 is a description of the application of the PLB to the analysis of close parallel runway operations. Derived from text

**N94-22427** Calgary Univ. (Alberta). Dept. of Geomatics Engineering.

**A ROBUST QUALITY CONTROL SYSTEM FOR GPS NAVIGATION AND KINEMATIC POSITIONING Ph.D. Thesis**  
 GOA YANG Sep. 1992 171 p  
 (ISBN-0-315-83148-0; CTN-94-60938) Copyright Avail:  
 Micromedia Ltd., Technical Information Centre, 240 Catherine  
 Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

The development and testing of a robust quality control system for global positioning system (GPS) navigation and kinematic positioning is described. The system is built upon the successful combination of well-known classical statistics with modern robust statistics. The theory of robust statistics was applied to make robust the standard Kalman filter and to formulate a robust failure signal generation function. Good performance in failure detection and failure identification, minimum implementation effort, and automation are the main criteria employed in the development of the system. Theoretical and numerical aspects of system modelling are presented along with the introduction of important concepts and the derivation of useful equations. Both the computational load and implementation effort were reduced to a minimum through various numerical techniques. The system was tested by applying it to integrity monitoring in GPS navigation and cycle slip detection and identification in GPS kinematic positioning. Results show that significant improvements have been achieved as compared to the conventional innovation based approach. Author (CISTI)

## 05

## AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

**N94-20561#** Naval Postgraduate School, Monterey, CA.  
**CONTROL VANE GUIDANCE FOR A DUCTED-FAN UNMANNED AIR VEHICLE M.S. Thesis**  
 PATRICK J. MORAN Jun. 1993 112 p  
 (AD-A271957) Avail: CASI HC A06/MF A02

Control of airborne vehicles was originally conceived to be done entirely by human pilots. Improvements in electronics in the last 50 years have allowed many flight control functions to become

automated, with the pilot continuously monitoring flight parameters from within the vehicle cockpit. With the advent of small unmanned air vehicles (UAV's) which are limited in size and weight-carrying capacity, a pilot is now able to fly an airborne vehicle from a distant ground-fixed position. Miniature electronic instruments control or direct vehicle movements either through pilot commands or autonomously. In order to accomplish reliable, continuous control of a UAV, many sensors are necessary aboard the vehicle. This thesis designed and installed necessary hardware and developed software to guide a UAV's aerodynamic control vanes, with feedback from sensors aboard the vehicle, in order to facilitate ground-based pilot control. Previous thesis work accomplished on this project achieved control of a UAV, named Archytas, in one degree-of-freedom, roll, while mounted on a test stand. Umbilical-controlled guidance of Archytas' control vanes from a forward-mounted sensor pod was set as the goal for this phase of the Archytas project. This work focused on modification of hardware to generate and access required signals, programming of analog-to-digital (A/D) and counter/timer peripheral boards mounted in a personal computer to control electrical and signal flow, and implementation of single-input-single-output (SISO) control equations developed concurrently in another thesis.

DTIC

**N94-21246#** Aurora Flight Sciences Corp., Manassas, VA.  
**LOW-COST, DUAL-USE PLATFORMS FOR ENVIRONMENTAL SENSING, PHASE 1**  
 MATTHEW G. HUTCHISON, JOHN S. LANGFORD, and CHARLES S. PRESTON 1993 47 p  
 (Contract N00014-93-C-0037)  
 (AD-A272951; AR-9305) Avail: CASI HC A03/MF A01

Recent advances in microelectronics, lightweight composite structures, and computational fluid mechanics have made possible a new generation of semi-autonomous, unmanned aircraft. Many of these unmanned aerial vehicles (UAV's) were originally conceived for purely military purposes, but the performance capabilities—in particular, the capacity for flights of extended range and endurance—have attracted the attention of the atmospheric and environmental research communities. While the application of UAV's to high-altitude research has been extensively investigated and documented, much less attention has been given to their potential role in low-altitude atmospheric studies. This report focuses on the application of unmanned aircraft to environmental sensing at low altitudes in the marine environment. There appear to be a number of missions in which a suitable UAV platform could provide unique opportunities for data collection that would greatly expand the current understanding of this vital region of the atmosphere. In addition to scientific contributions, the information collected at low altitude would also be of significant interest to the U.S. Navy for purposes varying from calibration of weapons guidance systems to initialization of computational models. DTIC

**N94-21283#** Naval Postgraduate School, Monterey, CA.  
**DESIGN, FABRICATION AND TEST OF A VERTICAL ATTITUDE TAKEOFF AND LANDING UNMANNED AIR VEHICLE M.S. Thesis**  
 ROBERT B. STONEY Jun. 1993 234 p  
 (AD-A273003) Avail: CASI HC A11/MF A03

Future fleet needs for real-time intelligence require an unmanned platform capable of operations from small surface combatants without the need for extensive support personnel and equipment and without causing disruption to the operations of the ship from which it operates. A candidate must not only takeoff and land vertically but also be capable of high forward flight speeds and efficient on-station performance. The design and initial fabrication of a Vertical Attitude Takeoff and Landing (VATOL) Unmanned Air Vehicle (UAV) airframe was completed at the Naval Postgraduate School. The vehicle, called Archytas, was a combination of two existing UAV's—the AROD and Aquila—as well as locally manufactured components, including a canard and wing spar. The objective of creating Archytas was to provide a proof-of-concept platform for research to explore performance

## 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

trade-offs and stability augmentation. A three-degree-of-freedom simulation was used as the focus of the design efforts, to validate design decisions made in the fields of propulsion, aerodynamics, structures and flight mechanics. Engine tests were conducted to determine thrust and control power. Structural components were designed, fabricated and then tested, making modifications where necessary to ensure sufficient airframe strength. A longitudinal control system was designed, validated by simulation, and tested structurally. DTIC

**N94-21418#** Naval Postgraduate School, Monterey, CA.  
**EFFECTS OF THRUST VECTOR CONTROL ON THE PERFORMANCE OF THE AEROBANG ORBITAL PLANE CHANGE MANEUVER M.S. Thesis**

RICHARD E. JOHNSON Jun. 1993 76 p  
(AD-A272532) Avail: CASI HC A05/MF A01

The aerobang maneuver, one of three types of aero-assisted orbital change methods, holds the possibility of reducing fuel consumption for orbital craft capable of atmospheric entry. It has been previously shown that different types of vehicles provide varying results over a constant heating rate trajectory. Further investigation into the optimization of the aerobang maneuver in this thesis includes the effects of using thrust vector control, the examination of the effects of increasing fuel mass fraction to increase orbital inclination changes, and the effects of that increase on both angle of attack and heating rate. The aerobang maneuver is shown to be capable of significant changes in orbital inclination in either a fixed heating rate or a fixed angle of attack mode for the Maneuverable Reentry Research Vehicle. DTIC

**N94-21507#** Quest Integrated, Inc., Kent, WA.  
**LOW-COST UNMANNED AIR VEHICLE (UAV) FOR OCEANOGRAPHIC RESEARCH Final Report, Apr. - Oct. 1993**

J. J. KOLLE Nov. 1993 26 p  
(Contract N00014-93-C-0029)  
(AD-A273103) Avail: CASI HC A03/MF A01

This Phase 1 study has demonstrated the feasibility of developing a low-cost unmanned air vehicle (UAV) designed for a range of oceanographic research missions, including photogrammetry, radiometry, video imaging, and atmospheric profiling, at altitudes of up to 3 km and a range of 300 km. The work included identification of a data link, control system, autopilot, automated launcher, and recovery parachute. These subsystems will allow straightforward programming of a wide range of mission profiles and instrumentation control and accurate aircraft positioning (including differential GPS positioning within 10 km of a ground station). We also demonstrated a low-cost radio-controlled aircraft capable of carrying a 4-kg instrument payload and an autopilot that minimizes the skill (or control algorithm complexity) required to fly the aircraft. We have estimated that a complete UAV system, including the ground station and all avionics, can be sold commercially for under \$35K. DTIC

**N94-21548#** Naval Postgraduate School, Monterey, CA.  
**DATA LINK DEVELOPMENT FOR THE ARCHYTAS VERTICAL TAKEOFF AND LANDING TRANSITIONAL FLIGHT UNMANNED AERIAL VEHICLE M.S. Thesis**

FREDERICK W. REICHERT, JR. 17 Jun. 1993 94 p  
(AD-A272499) Avail: CASI HC A05/MF A01

The development of a data link for the Archytas, a vertical takeoff and landing, transitional flight unmanned aerial vehicle (UAV) prototype being built by the Aeronautics Department at the Naval Postgraduate School, is chronicled. Archytas is intended to be a proof-of-concept platform to satisfy the Navy's real-time, over-the-horizon intelligence mission with a UAV that could be launched and recovered from a small combatant ship. A history of the Archytas command and control data link development, a full description of the data link as delivered for use on the prototype, principles for near term enhancements, and future considerations for the data link should the Archytas concept be adapted for use in an operational combat environment are provided. DTIC

**N94-21592\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**SURVEY OF LIFT-FAN AERODYNAMIC TECHNOLOGY**

DAVID H. HICKEY and JERRY V. KIRK Sep. 1993 74 p  
(Contract NASA ORDER A-25364-D)  
(NASA-CR-177615; A-93106; NAS 1.26:177615) Avail: CASI HC A04/MF A01

Representatives of NASA Ames Research Center asked that a summary of technology appropriate for lift-fan powered short takeoff/vertical landing (STOVL) aircraft be prepared so that new programs could more easily benefit from past research efforts. This paper represents one of six prepared for that purpose. The authors have conducted or supervised the conduct of research on lift-fan powered STOVL designs and some of their important components for decades. This paper will first address aerodynamic modeling requirements for experimental programs to assure realistic, trustworthy results. It will next summarize the results or efforts to develop satisfactory specialized STOVL components such as inlets and flow defectors. It will also discuss problems with operation near the ground, aerodynamics while under lift-fan power, and aerodynamic prediction techniques. Finally, results of studies to reduce lift-fan noise will be presented. The paper will emphasize results from large scale experiments, where available, for reasons that will be brought out in the discussion. Some work with lift-engine powered STOVL aircraft is also applicable to lift-fan technology and will be presented herein. Small-scale data will be used where necessary to fill gaps. Author

**N94-22598#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. fuer Experimentelle Stromungsmechanik.

**SURFACE HOT FILM MEASUREMENTS AT ATTAS LAMINAR GLOVE [OBERFLAECHEHEISSFILMMESSUNGEN AM ATTAS-LAMINARHANDSCHUH]**

H.-P. KREPLIN and G. HOEHLER /In Tech. Univ. Berlin, Measurement Technology for Flight Tests p 1-11 May 1991 In GERMAN

Avail: CASI HC A03/MF A02

The surface hot film technique, which was used for free flight tests with the German research aircraft ATTAS, is described. The experiments were carried out in order to obtain criteria for the laminar turbulent boundary transition in swept wings in the framework of a research program on transonic laminar wings. The surface hot film technique was used for observing unstationary processes with high time resolution. V-shaped double sensors were used. The sensors are made of two nickel films on a thin plastic foil. Nine sensors were mounted in the middle section of the glove, and two sensors were located in internal and external glove sides on the nose. All were operated with constant temperature anemometers in the aircraft cabin. The probability distributions of laminar and turbulent signals amplitudes are shown to be similar to a Gaussian distribution. The intermittency factor could be evaluated considering the cumulative amplitude distribution function. It is concluded that the method is useful provided perturbations such as electronic noise do not influence the information. ESA

**N94-22623\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**DEMONSTRATING DAMAGE TOLERANCE OF COMPOSITE AIRFRAMES**

CLARENCE C. POE, JR. /In its Computational Methods for Failure Analysis and Life Prediction p 323-345 Oct. 1993  
Avail: CASI HC A03/MF A03

Commercial transport aircraft operating in the United States are certified by the Federal Aviation Authority to be damage tolerant. On 28 April 1988, Aloha Airlines Flight 243, a Boeing 727-200 airplane, suffered an explosive decompression of the fuselage but landed safely. This event provides very strong justification for the damage tolerant design criteria. The likely cause of the explosive decompression was the linkup of numerous small fatigue cracks that initiated at adjacent fastener holes in the lap splice joint at the side of the body. Actually, the design should

have limited the damage size to less than two frame spacings (about 40 inches), but this type of 'multi-site damage' was not originally taken into account. This cracking pattern developed only in the high-time airplanes (many flights). After discovery in the fleet, a stringent inspection program using eddy current techniques was inaugurated to discover these cracks before they linked up. Because of concerns about safety and the maintenance burden, the lap-splice joints of these high-time airplanes are being modified to remove cracks and prevent new cracking; newer designs account for 'multi-site damage'. Author (revised)

## 07

## AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

**N94-21268#** Martin Marietta Labs., Baltimore, MD.  
**APPLICABILITY AND PERFORMANCE BENEFITS OF XD (TRADENAME) TITANIUM ALUMINIDES TO EXPENDABLE GAS TURBINE ENGINES** Final Report, 1 Oct. 1991 - 31 Mar. 1993

PAMELA SADLER, K. S. KUMAR, and JOHN A. GREEN Aug. 1993 168 p  
(Contract DAAL04-91-C-0034)  
(AD-A272998; MML-TR-93-09; ARL-CR-61) Avail: CASI HC A08/MF A02

The purpose of this program was to produce XD-TiAl compressor rotors for the experimental P9005 gas turbine engine to be used in the Army's Integrated High Performance Turbine Engine Technology program. Specific tasks included the casting of XD-titanium aluminide, processing optimization, component design analysis modifications and final component machining to specifications. Specifically, an ingot of a Ti-45Al-2Mn-2V alloy containing 7 volume % TiB<sub>2</sub> was cast and then HIPed to eliminate residual porosity. Eight cylinders were machined from the HIPed material and isothermally forged. Microstructural analysis and mechanical property evaluation were performed on representative forgings. Several heat treatment schedules were examined, and the resulting microstructures were characterized using x-ray diffraction, optical and scanning electron microscopy. From these analyses, heat treatments were identified. Tensile behavior as a function of temperature, fracture toughness at room and elevated temperatures, creep resistance and fatigue response were evaluated. Fracture surfaces were characterized. Based on the observed mechanical properties, heat-treatment schedules were identified for the remaining forgings intended to be machined into final components. Williams International performed a detailed design analysis for the rotor. A local vendor was identified to machine the final component. DTIC

**N94-21563#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**THRUST AUGMENTATION OPTIONS FOR THE BETA 2 TWO-STAGE-TO-ORBIT VEHICLE**

CHRISTOPHER A. SNYDER Dec. 1993 17 p Presented at the AIAA Aircraft Design, Systems and Operations Meeting, Monterey, CA, 11-13 Aug. 1993; sponsored by AIAA (Contract RTOP 505-70-00)  
(NASA-TM-106448; E-8301; NAS 1.15:106448; AIAA PAPER 93-4014) Avail: CASI HC A03/MF A01

NASA LeRC is continuing to study propulsion concepts for a horizontal takeoff and landing, fully reusable, two-stage-to-orbit vehicle. This will be capable of launching and returning a 10,000 pound payload to a 100 nautical mile polar orbit using low-risk technology. The vehicle, Beta 2, is a derivative of the USAF/Boeing Beta vehicle which was designed to deliver a 50,000 pound payload to a similar orbit. Beta 2 stages at Mach 6.5 and about 100,000 ft

altitude. The propulsion system for the booster is an over/under turbine bypass engine/ramjet configuration. In this paper, several options for thrust augmentation were studied in order to improve the performance of this engine where there was a critical need. Options studies were turbine engine overspeed in the transonic region, water injection at a various turbine engine locations also during the transonic region, and water injection at the turbine engine face during high speed operation. The methodology, constraints, propulsion performance, and mission study results are presented. Author (revised)

**N94-21582#** General Motors Corp., Indianapolis, IN. Allison Gas Turbine Div.

**FLOW INTERACTION EXPERIMENT. VOLUME 1:**

**AEROTHERMAL MODELING, PHASE 1 Final Report**

M. NIKJOOY, H. C. MONGIA, J. P. SULLIVAN (Purdue Univ., West Lafayette, IN.), and S. N. B. MURTHY (Purdue Univ., West Lafayette, IN.) Nov. 1993 338 p Original contains color illustrations  
(Contract NAS3-24350; RTOP 505-62-52)  
(NASA-CR-189192-VOL-1; E-8177-VOL-1; EDR-16026; NAS 1.26:189192-VOL-1) Avail: CASI HC A15/MF A03; 16 functional color pages

An experimental and computational study is reported for the flow of a turbulent jet discharging into a rectangular enclosure. The experimental configurations consisting of primary jets only, annular jets only, and a combination of annular and primary jets are investigated to provide a better understanding of the flow field in an annular combustor. A laser Doppler velocimeter is used to measure mean velocity and Reynolds stress components. Major features of the flow field include recirculation, primary and annular jet interaction, and high turbulence. A significant result from this study is the effect the primary jets have on the flow field. The primary jets are seen to create statistically larger recirculation zones and higher turbulence levels. In addition, a technique called marker nephelometry is used to provide mean concentration values in the model combustor. Computations are performed using three levels of turbulence closures, namely k-epsilon model, algebraic second moment (ASM), and differential second moment (DSM) closure. Two different numerical schemes are applied. One is the lower-order power-law differencing scheme (PLDS) and the other is the higher-order flux-spline differencing scheme (FSDS). A comparison is made of the performance of these schemes. The numerical results are compared with experimental data. For the cases considered in this study, the FSFS is more accurate than the PLDS. For a prescribed accuracy, the flux-spline scheme requires a far fewer number of grid points. Thus, it has the potential for providing a numerical error-free solution, especially for three-dimensional flows, without requiring an excessively fine grid. Although qualitatively good comparison with data was obtained, the deficiencies regarding the modeled dissipation rate (epsilon) equation, pressure-strain correlation model, and the inlet epsilon profile and other critical closure issues need to be resolved before one can achieve the degree of accuracy required to analytically design combustion systems. Author (revised)

**N94-21583#** General Motors Corp., Indianapolis, IN. Allison Gas Turbine Div.

**FLOW INTERACTION EXPERIMENT. VOLUME 2:**

**AEROTHERMALMODELING, PHASE 2 Final Report**

M. NIKJOOY, H. C. MONGIA, J. P. SULLIVAN (Purdue Univ., West Lafayette, IN.), and S. N. B. MURTHY (Purdue Univ., West Lafayette, IN.) Nov. 1993 307 p Original contains color illustrations  
(Contract NAS3-24350; RTOP 505-62-52)  
(NASA-CR-189192-VOL-2; E-8180-VOL-2; EDR-16026; NAS 1.26:189192-VOL-2) Avail: CASI HC A14/MF A03; 12 functional color pages

An experimental and computational study is reported for the flow of a turbulent jet discharging into a rectangular enclosure. The experimental configurations consisting of primary jets only, annular jets only, and a combination of annular and primary jets are investigated to provide a better understanding of the flow



field in an annular combustor. A laser Doppler velocimeter is used to measure mean velocity and Reynolds stress components. Major features of the flow field include recirculation, primary and annular jet interaction, and high turbulence. A significant result from this study is the effect the primary jets have on the flow field. The primary jets are seen to create statistically larger recirculation zones and higher turbulence levels. In addition, a technique called marker nephelometry is used to provide mean concentration values in the model combustor. Computations are performed using three levels of turbulence closures, namely k-epsilon model, algebraic second moment (ASM), and differential second moment (DSM) closure. Two different numerical schemes are applied. One is the lower-order power-law differencing scheme (PLDS) and the other is the higher-order flux-spline differencing scheme (FSDS). A comparison is made of the performance of these schemes. The numerical results are compared with experimental data. For the cases considered in this study, the FSDS is more accurate than the PLDS. For a prescribed accuracy, the flux-spline scheme requires a far fewer number of grid points. Thus, it has the potential for providing a numerical error-free solution, especially for three-dimensional flows, without requiring an excessively fine grid. Although qualitatively good comparison with data was obtained, the deficiencies regarding the modeled dissipation rate (epsilon) equation, pressure-strain correlation model, and the inlet epsilon profile and other critical closure issues need to be resolved before one can achieve the degree of accuracy required to analytically design combustion systems. Author (revised)

**N94-21586\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

## **BLADE ROW INTERACTION EFFECTS ON FLUTTER AND FORCED RESPONSE**

DANIEL H. BUFFUM Dec. 1993 19 p Presented at the 29th Joint Propulsion Conference, Monterey, CA, 28 Jun. - 1 Jul. 1993; cosponsored by AIAA, SAE, ASME, and ASEE See also A93-49911 (Contract RTOP 505-62-10) (NASA-TM-106438; E-8280; NAS 1.15:106438; AIAA PAPER 93-2084) Avail: CASI HC A03/MF A01

In the flutter or forced response analysis of a turbomachine blade row, the blade row in question is commonly treated as if it is isolated from the neighboring blade rows. Disturbances created by vibrating blades are then free to propagate away from this blade row without being disturbed. In reality, neighboring blade rows will reflect some portion of this wave energy back toward the vibrating blades, causing additional unsteady forces on them. It is of fundamental importance to determine whether or not these reflected waves can have a significant effect on the aeroelastic stability or forced response of a blade row. Therefore, a procedure to calculate intra-blade-row unsteady aerodynamic interactions was developed which relies upon results available from isolated blade row unsteady aerodynamic analyses. In addition, an unsteady aerodynamic influence coefficient technique is used to obtain a model for the vibratory response in which the neighboring blade rows are also flexible. The flutter analysis shows that interaction effects can be destabilizing, and the forced response analysis shows that interaction effects can result in a significant increase in the resonant response of a blade row. Author (revised)

**N94-21758\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

## **COMPARISON OF MIXING CALCULATIONS FOR REACTING AND NON-REACTING FLOWS IN A CYLINDRICAL DUCT**

V. L. OECHSLE (General Motors Corp., Indianapolis, IN.), H. C. MONGIA (General Motors Corp., Indianapolis, IN.), and J. D. HOLDEMAN Jan. 1994 23 p Proposed for presentation at the 32nd Aerospace Sciences Meeting and Exhibit, Reno, NV, 10-13 Jan. 1994; sponsored by AIAA Original contains color illustrations

(Contract RTOP 537-02-21)

(NASA-TM-106435; E-8277; NAS 1.15:106435; AIAA PAPER

94-0865) Avail: CASI HC A03/MF A01; 4 functional color pages

A production 3-D elliptic flow code has been used to calculate

non-reacting and reacting flow fields in an experimental mixing section relevant to a rich burn/quick mix/lean burn (RQL) combustion system. A number of test cases have been run to assess the effects of the variation in the number of orifices, mass flow ratio, and rich-zone equivalence ratio on the flow field and mixing rates. The calculated normalized temperature profiles for the non-reacting flow field agree qualitatively well with the normalized conserved variable isopleths for the reacting flow field indicating that non-reacting mixing experiments are appropriate for screening and ranking potential rapid mixing concepts. For a given set of jet momentum-flux ratio, mass flow ratio, and density ratio (J, MR, and DR), the reacting flow calculations show a reduced level of mixing compared to the non-reacting cases. In addition, the rich-zone equivalence ratio has noticeable effect on the mixing flow characteristics for reacting flows. Author (revised)

**N94-21759\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

## **OPTIONS FOR THRUST AUGMENTATION FOR THE BETA 2 TWO-STAGE-TO-ORBIT LAUNCH VEHICLE**

KENOL JULES Dec. 1993 15 p

(Contract RTOP 505-70-00)

(NASA-TM-106418; E-8255; NAS 1.15:106418) Avail: CASI HC A03/MF A01

A study to improve the performance of the NASA two-stage-to-orbit vehicle was undertaken. The NASA concept, a horizontal takeoff and landing, fully reusable, two-stage to orbit vehicle, will be capable of launching and returning a 10,000 pound payload to a 100 nmi polar orbit. The vehicle, Beta 2, is a derivative of the USAF/Boeing Beta vehicle which was designed to deliver a 50,000 pound payload to a similar orbit. Beta 2 stages at Mach 6.5 and about 100,000 feet altitude. The propulsion system for the booster is an over/under turbine engine/ramjet configuration. In this paper a study was performed for one of the candidate engines, the variable cycle engine, to assess its potential to meet the required performance needs of the Beta 2 vehicle. Several options for thrust augmentation were studied in order to improve the performance of the engine where there was a critical need. The methodology, constraints, propulsion performance, and mission study results are presented. Author (revised)

**N94-21879\*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.

## **ON THE ESTIMATION ALGORITHM USED IN ADAPTIVE PERFORMANCE OPTIMIZATION OF TURBOFAN ENGINES**

MARTIN D. ESPANA and GLENN B. GILYARD Dec. 1993 34 p Presented at the AIAA Joint Propulsion Conference, Monterey, CA, 28 Jun. - 1 Jul. 1993 See also A93-49710

(Contract RTOP 533-02-39)

(NASA-TM-4551; H-1908; NAS 1.15:4551; AIAA PAPER 93-1823)

Avail: CASI HC A03/MF A01

The performance seeking control algorithm is designed to continuously optimize the performance of propulsion systems. The performance seeking control algorithm uses a nominal model of the propulsion system and estimates, in flight, the engine deviation parameters characterizing the engine deviations with respect to nominal conditions. In practice, because of measurement biases and/or model uncertainties, the estimated engine deviation parameters may not reflect the engine's actual off-nominal condition. This factor has a necessary impact on the overall performance seeking control scheme exacerbated by the open-loop character of the algorithm. The effects produced by unknown measurement biases over the estimation algorithm are evaluated. This evaluation allows for identification of the most critical measurements for application of the performance seeking control algorithm to an F100 engine. An equivalence relation between the biases and engine deviation parameters stems from an observability study; therefore, it is undecided whether the estimated engine deviation parameters represent the actual engine deviation or whether they simply reflect the measurement biases. A new algorithm, based on the engine's (steady-state) optimization model, is proposed and tested with flight data. When compared with previous Kalman filter schemes, based on local engine dynamic

models, the new algorithm is easier to design and tune and it reduces the computational burden of the onboard computer.

Author (revised)

## 08

## AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

**N94-20524\*** Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

**IMPROVEMENT OF HELICOPTER ATTITUDE STABILITY BY ACTIVE CONTROL OF THE CONVENTIONAL SWASH PLATE**  
Final Report, Nov. 1986 - Dec. 1993

NORMAN D. HAM Dec. 1993 10 p

(Contract NCC2-447)

(NASA-CR-194786; NAS 1.26:194786; VTL-TR-198-6) Avail: CASI HC A02/MF A01

The Final Report on improvement of helicopter attitude stability by active control of the conventional swash plate covering the period from Nov. 1986 to Dec. 1993 is presented. A paper on the history, principles, and applications of helicopter individual-blade-control is included. CASI

**N94-20556\*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**APPARATUS AND METHOD FOR IMPROVING SPIN RECOVERY ON AIRCRAFT Patent**

H. PAUL STOUGH, II, inventor (to NASA) 2 Nov. 1993 9 p Filed 21 Sep. 1992 Supersedes N93-20039 (31 - 7, p 1786)

(NASA-CASE-LAR-14747-1; US-PATENT-5,259,573; US-PATENT-APPL-SN-948057; US-PATENT-CLASS-244-75R; US-PATENT-CLASS-244-87; INT-PATENT-CLASS-B64C-9/02)

Avail: US Patent and Trademark Office

Previous research on airplane spinning and recovery has shown that at potential spin conditions (high angles of attack with rotation) the horizontal tail, depending upon its location, can create a wake about the vertical tail and rudder which can adversely affect airplane spin and recovery characteristics. Many methods of altering the tail geometry to modify these interference effects were investigated for improving airplane spin and recovery characteristics. Examples of changes includes relocation of the horizontal tail, increasing control surface travel, and use of a 'flip tail' that can be rotated to extreme angles for spin recovery. A device is provided which improves the spin recovery characteristics of aircraft which involves attaching the horizontal tail of the aircraft to the aircraft such that a gap remains between the root end of each horizontal tail section and the fuselage or vertical tail of the aircraft. The gaps measure between about 15 and 30 percent of the tail semispan. The gaps may be covered by shields which are released should a spin occur. Official Gazette of the U.S. Patent and Trademark Office

**N94-21050** Honeywell, Inc., Phoenix, AZ.

**OPTIMAL FLIGHT GUIDANCE FOR AIRCRAFT IN WINDSHEAR Patent**

TERRY L. ZWEIFEL, inventor (to Honeywell, Inc.) and J. RENE BARRIOS, inventor (to Honeywell, Inc.) 15 Sep. 1992 28 p Filed 8 Dec. 1987

(CA-PATENT-1,307,573; INT-PATENT-CLASS-B64C-13/16; CTN-93-60686) Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC/MF

An apparatus is provided for controlling the vertical flight path of an aircraft encountering a windshear condition. The apparatus provides guidance commands to optimize the resultant flight path of the aircraft and maximize time in the air and distance travelled. When operating in the presence of a tail windshear, a fixed flight path angle independent of the windshear magnitude is commanded

that minimizes excitation of the aircraft's phugoid oscillatory mode while maintaining adequate clearance of hills and buildings that may be present around the airport. In the presence of a vertical wind component, the effect on the aircraft's flight path angle is computed and added to the fixed flight path angle command. The guidance command is limited in magnitude to preclude commands which would cause the aircraft to exceed the maximum allowable angle of attack. An angle of attack sensor provides a signal which is combined with a sensed pitch angle to derive a signal corresponding to the actual flight path angle. A command signal corresponding to a fixed flight path angle at a predetermined elevation is combined with a signal corresponding to the effective change in flight path angles due to a vertical windshear component and with the actual flight path angle to derive the pitch command signal. Author (CISTI)

**N94-21742\*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**A COMPARATIVE ROBUSTNESS EVALUATION OF FEEDFORWARD NEUROFILTERS**

TERRY TROUDET (Sverdrup Technology, Inc., Brook Park, OH.) and WALTER MERRILL Dec. 1993 11 p Proposed for presentation at the 32nd Aerospace Sciences Meeting and Exhibit, Reno, NV, 10-13 Jan. 1994; sponsored by AIAA

(Contract NAS3-25266; RTOP 584-03-11) (NASA-TM-106440; E-8282; NAS 1.15:106440; AIAA PAPER 94-0397) Avail: CASI HC A03/MF A01

A comparative performance and robustness analysis is provided for feedforward neurofilters trained with back propagation to filter additive white noise. The signals used in this analysis are simulated pitch rate responses to typical pilot command inputs for a modern fighter aircraft model. Various configurations of nonlinear and linear neurofilters are trained to estimate exact signal values from input sequences of noisy sampled signal values. In this application, nonlinear neurofiltering is found to be more efficient than linear neurofiltering in removing the noise from responses of the nominal vehicle model, whereas linear neurofiltering is found to be more robust in the presence of changes in the vehicle dynamics. The possibility of enhancing neurofiltering through hybrid architectures based on linear and nonlinear neuroprocessing is therefore suggested as a way of taking advantage of the robustness of linear neurofiltering, while maintaining the nominal performance advantage of nonlinear neurofiltering. Author (revised)

## 09

## RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

**N94-20511\*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**NEW TECHNIQUE FOR OIL BACKSTREAMING CONTAMINATION MEASUREMENTS**

S. A. ALTEROVITZ, H. J. SPEIER, R. M. SIEG (Cleveland State Univ., OH.), M. N. DROTOS (Cleveland State Univ., OH.), and J. E. DUNNING (Michigan State Univ., East Lansing.) *In its Solid State Technology Branch of NASA Lewis Research Center: Fifth Annual Digest* p 157-162 Aug. 1993 Repr. from American Inst. of Physics, Applied Physics Letter, v. 73, no. 4, 1 Jul./Aug. 1992

Avail: CASI HC A02/MF A03

Due to the large size and the number of diffusion pumps, space simulation chambers cannot be easily calibrated by the usual test dome method for measuring backstreaming from oil diffusion pumps. In addition, location dependent contamination may be an important parameter of the test. The backstreaming contamination in the Space Power Facility (SPF) near Sandusky,



## 09 RESEARCH AND SUPPORT FACILITIES (AIR)

Ohio, the largest space simulation vacuum test chamber in the U.S.A. was measured. Small size clean silicon wafers as contamination sensors placed at all desired measurement sites were used. The facility used diffusion pumps with DC 705 oil. The thickness of the contamination oil film was measured using ellipsometry. Since the oil did not wet uniformly the silicon substrate, two analysis models were developed to measure the oil film: continuous, homogeneous film and islands of oil with the islands varying in coverage fraction and height. In both cases, the contamination film refractive index was assumed to be that of DC 705. The second model improved the ellipsometric analysis quality parameter by up to two orders of magnitude, especially for the low coverage cases. Comparison of the two models for our case shows that the continuous film model overestimates the oil volume by less than 50 percent. Absolute numbers for backstreaming are in good agreement with published results for diffusion pumps. Good agreement was also found between the ellipsometric results and measurements done by x ray photoelectron spectroscopy (XPS) and by scanning electron microscopy (SEM) on samples exposed to the same vacuum runs. Author (revised)

**N94-21239#** Army Cold Regions Research and Engineering Lab., Hanover, NH.

### NOTES ON ANTARCTIC AVIATION

MALCOLM MELLOR Aug. 1993 154 p

(AD-A273018; CRREL-93-14) Avail: CASI HC A08/MF A02

Antarctic aviation has been evolving for the best part of a century, with regular air operations developing over the past three or four decades. Antarctica is the last continent where aviation still depends almost entirely on expeditionary airfields and 'bush flying', but change seems imminent. This report describes the history of aviation in Antarctica, the types and characteristics of existing and proposed airfield facilities, and the characteristics of aircraft suitable for Antarctic use. It now seems possible for Antarctic aviation to become an extension of mainstream international aviation. The basic requirement is a well-distributed network of hard-surface airfields that can be used safely by conventional aircraft, together with good international collaboration. The technical capabilities already exist. DTIC

**N94-21280#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Hauptabt. Windkanalee.

### DESCRIPTION AND ASSESSMENT OF A NEW OPTICAL PRESSURE MEASUREMENT SYSTEM (OPMS) DEMONSTRATED IN THE HIGH SPEED WIND TUNNEL IN GOETTINGEN (GERMANY)

R. H. ENGLER, K. HARTMANN, I. TROYANOVSKI (INTECO s.r.l., Frosione, Italy.), and A. VOLLAN (Omega G.m.b.H., Immenstaad, Germany.) Oct. 1992 66 p In GERMAN Original contains color illustrations

(DLR-FB-92-24; ETN-93-94868) Avail: CASI HC A04/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne 90, Germany

An assessment of a novel Optical Pressure Measurement System (OPMS) made in a high speed wind tunnel is reported. A model of a cropped delta wing was made available to demonstrate and assess OPMS. For this purpose pressure distributions were measured separately as well as simultaneously with both OPMS and a conventional technique via pressure taps for comparisons. Temperature variations on the model surface were determined by means of an infrared camera and thermocouples in order to assess a possible error caused by temperature changes. Surface oil flow visualizations were performed in order to get additional information on boundary layer transition, separation and reattachment lines as well as vortex positions. ESA

**N94-22418** Carleton Univ., Ottawa (Ontario). Dept. of Civil Engineering.

### PASSENGER TERMINAL LEVEL OF SERVICE MEASUREMENT: A UTILITY THEORETIC APPROACH M.S. Thesis

KHIZER FAROOQ OMER May 1990 317 p

(ISBN-0-315-59037-8; CTN-94-60885) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

The relationship between the existing space/service standards of various processors of an airport system is investigated, along with the user-perceived values of these space/service standards. The various processors include check-in, baggage claim, boarding lounge, and preliminary inspection line. The utility of these standards and the level of service of various airport subsystems are formulated. A utility theoretic approach is used to measure the airport landside level of service. Attitudinal surveys of airport users were conducted at Ottawa and Toronto international airports. For the airport processors mentioned above, the selected performance measures were studied to arrive at the individual as well as composite utility of those processors. Equations for the utility functions of those processors have been calculated and their application in developing airport landside level of service standards is discussed. The use of these individual and composite utility functions for each processor is described and recommendations are made for further research. Author (CISTI)

**N94-22419** New Brunswick Univ., Fredericton. Dept. of Civil Engineering.

### AN AIRPORT ECONOMIC IMPACT STUDY PROCEDURE FOR ATLANTIC CANADA M.S. Thesis

TERRY MARK MAZEROLLE Aug. 1990 138 p

(ISBN-0-315-59445-4; CTN-94-60886) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

A methodology was developed for economic impact studies suitable for the size of airport and economic conditions extant in Atlantic Canada. The methodology enables quantification of the net economic impact of an airport on the surrounding economy as an employer and as a consumer of goods and services. Three levels of airport dependent impacts were defined. Direct impacts are those economic activities derived from airport dependent firms and from operation of the airport. Indirect impacts are the effect of the expenditures of airport dependent firms and the subsequent rounds of spending which occur in the local economy as a result. Induced impacts measure the effect of the wages of those employed by airport dependent firms. The airport's total impact is the sum of the direct, indirect, and induced impacts. The methodology of data collection described was explored with a case study at Fredericton Airport. The results showed that the airport is a far more valuable economic resource than was commonly perceived. It is concluded that a unique methodology was necessary to measure accurately the economic impact of an airport in the Atlantic region of Canada. Author (CISTI)

**N94-22423** Waterloo Univ. (Ontario). Dept. of Civil Engineering.

### PASSENGER TERMINAL SIMULATION MODEL Ph.D. Thesis

JOSE REYNALDO ANSELM SETTI 1990 198 p

(ISBN-0-315-61113-8; CTN-94-60890) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

A high-level computer program called TERMSIM has been developed to simulate passenger terminal operation in terms of number of passengers arriving, being served, and queueing at the various terminal facilities. It is assumed that passenger movements may be represented as a fluid flowing through a system of interconnected reservoirs corresponding to terminal components. Paxgraphs, functions describing passenger arrivals as a function of time before flight departure or after flight arrival, are used to generate passenger flows for user-defined discrete time intervals. The simulation analyzes passenger movement through the predetermined paths within the terminal. Operation of the terminal facilities is simulated by calculating output flows and queue lengths given input flows, queue lengths, and service characteristics at the end of discrete time intervals. Seven preprogrammed models have been developed to simulate terminal components, the passenger greeter and bag matching processes, and departure concourse and ancillary facilities. The capabilities of TERMSIM are demonstrated through a simulation of a typical day at Toronto

International Airport, and results are shown to be similar to those produced by the Transport Canada simulation model. A guide to the use of TERMSIM is included. Author (CISTI)

**N94-22425** Calgary Univ. (Alberta). Dept. of Civil Engineering. **A STUDY OF PARALLEL PIER FINGER AIRPORT TERMINAL CONFIGURATION M.S. Thesis**

EZEKIEL SUNDAY DADA Dec. 1992 167 p (ISBN-0-315-83128-6; CTN-94-60936) Copyright Avail: Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

Taxiing, walking, baggage transport, and airport construction were studied to determine their effect on the geometry of pier finger terminals. The best terminal geometry based on taxiing alone is one with shorter fingers in the middle and longer ones at the ends. On the other hand, geometry that minimizes baggage transportation distance is the one with the longest pier at the center. Baggage transportation distance is affected both by the geometry of the terminal and the sorting room strategy adopted. Decentralized sorting gives a lower baggage tractor distance than centralized sorting. Walking distance has been studied extensively by others who found that pier finger terminals minimize walking. As far as the operations considered are concerned, the terminal with pier lengths decreasing with distance from the center gives the best combined optimal geometry. It also gives a lower number of piers than that found by others for walking only.

Author (CISTI)

## 10

## ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

**N94-20367\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**SPACE STATION TRASH REMOVAL SYSTEM Patent**

ANDREW J. PETRO, inventor (to NASA) 7 Sep. 1993 5 p Filed 22 May 1992 Supersedes N92-30315 (30 - 21, p 3588) (NASA-CASE-MSC-21723-1; US-PATENT-5,242,134; US-PATENT-APPL-SN-887001; US-PATENT-CLASS-244-158R; US-PATENT-CLASS-244-160; INT-PATENT-CLASS-B64G-1/22) Avail: US Patent and Trademark Office

A trash removal system for space stations is described. The system is comprised of a disposable trash bag member and an attached, compacted large, lightweight inflatable balloon element. When the trash bag member is filled, the astronaut places the bag member into space through an airlock. Once in the vacuum of space, the balloon element inflates. Due to the large cross-sectional area of the balloon element relative to its mass, the combined balloon element and the trash bag member are slowed by atmospheric drag to a much greater extent than the Space Station's. The balloon element and bag member lose altitude and re-enter the atmosphere, and the elements and contents are destroyed by aerodynamic heating. The novelty of this system is in the unique method of using the vacuum of space and aerodynamic heating to dispose of waste material with a minimum of increase in orbital debris.

Official Gazette of the U.S. Patent and Trademark Office

**N94-20590\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**TETRAHEDRAL LANDER Patent**

MICHAEL L. ROBERTS, inventor (to NASA) 30 Nov. 1993 7 p Filed 3 Feb. 1993 Supersedes N94-15951 (32 - 3, p 886) (NASA-CASE-MSC-22082-1; US-PATENT-5,265,829;

US-PATENT-APPL-SN-012839; US-PATENT-CLASS-244-160; US-PATENT-CLASS-244-138A; US-PATENT-CLASS-244-100A; US-PATENT-CLASS-244-110D; US-PATENT-CLASS-244-113; US-PATENT-CLASS-244-158A; US-PATENT-CLASS-244-138R) Avail: US Patent and Trademark Office

An apparatus and method is disclosed for decelerating and absorbing impact of a re-entry vehicle suitable for payloads that are relatively light as well as payloads weighing several tons or more. The apparatus includes four inflatable legs displaced equidistantly from each other around a capsule or housing which contains a payload. The legs are inflated at a designated altitude after entering earth's atmosphere to slow the descent of the re-entry vehicle. Connected between each of the four legs are drag inducing surfaces that deploy as the legs inflate. The drag inducing surfaces are triangularly shaped with one such surface being connected between each pair of legs for a total of six drag inducing surfaces. The legs have drag inducing outer surfaces which act to slow the descent of the re-entry vehicle.

Official Gazette of the U.S. Patent and Trademark Office

**N94-21790\*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**THE 1992 SEALS FLOW CODE DEVELOPMENT WORKSHOP**

ANITA D. LIANG and ROBERT C. HENDRICKS Oct. 1993 278 p Workshop held in Cleveland, OH, 5-6 Aug. 1992 (Contract NAS3-25644; RTOP 590-21-11) (NASA-CP-10124; E-8172; NAS 1.55:10124) Avail: CASI HC A13/MF A03

A two-day meeting was conducted at the NASA Lewis Research Center on August 5 and 6, 1992, to inform the technical community of the progress of NASA Contract NAS3-26544. This contract was established in 1990 to develop industrial and CFD codes for the design and analysis of seals. Codes were demonstrated and disseminated to the user community for evaluation. The peer review panel which was formed in 1991 provided recommendations on this effort. The technical community presented results of their activities in the area of seals, with particular emphasis on brush seal systems.

**N94-21874\*** Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.

**BRAYTON POWER CONVERSION SYSTEM PARAMETRIC DESIGN MODELLING FOR NUCLEAR ELECTRIC PROPULSION Final Report**

THOMAS L. ASHE (Allied-Signal Aerospace Co., Tempe, AZ.) and WILLIAM D. OTTING 21 Nov. 1993 160 p (Contract NAS3-25808; RTOP 593-72-00) (NASA-CR-191135; NAS 1.26:191135; REPT-93RC-010143) Avail: CASI HC A08/MF A02

The parametrically based closed Brayton cycle (CBC) computer design model was developed for inclusion into the NASA LeRC overall Nuclear Electric Propulsion (NEP) end-to-end systems model. The code is intended to provide greater depth to the NEP system modeling which is required to more accurately predict the impact of specific technology on system performance. The CBC model is parametrically based to allow for conducting detailed optimization studies and to provide for easy integration into an overall optimizer driver routine. The power conversion model includes the modeling of the turbines, alternators, compressors, ducting, and heat exchangers (hot-side heat exchanger and recuperator). The code predicts performance to significant detail. The system characteristics determined include estimates of mass, efficiency, and the characteristic dimensions of the major power conversion system components. These characteristics are parametrically modeled as a function of input parameters such as the aerodynamic configuration (axial or radial), turbine inlet temperature, cycle temperature ratio, power level, lifetime, materials, and redundancy.

Author

## CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

**N94-20377\*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**IMPROVED CERAMIC SLIP CASTING TECHNIQUE Patent**

GREGORY M. BUCK, inventor (to NASA) and PETER VASQUEZ, inventor (to NASA) 30 Nov. 1993 3 p Filed 22 Sep. 1992 Supersedes N93-20041 (31 - 7, 1858)

(NASA-CASE-LAR-14471-1; US-PATENT-5,266,252;

US-PATENT-APPL-SN-950580; US-PATENT-CLASS-264-86;

US-PATENT-CLASS-264-221; INT-PATENT-CLASS-C04B-33/28)

Avail: US Patent and Trademark Office

A primary concern in modern fluid dynamics research is the experimental verification of computational aerothermodynamic codes. This research requires high precision and detail in the test model employed. Ceramic materials are used for these models because of their low heat conductivity and their survivability at high temperatures. To fabricate such models, slip casting techniques were developed to provide net-form, precision casting capability for high-purity ceramic materials in aqueous solutions. In previous slip casting techniques, block, or flask molds made of plaster-of-paris were used to draw liquid from the slip material. Upon setting, parts were removed from the flask mold and cured in a kiln at high temperatures. Casting detail was usually limited with this technique -- detailed parts were frequently damaged upon separation from the flask mold, as the molded parts are extremely delicate in the uncured state, and the flask mold is inflexible. Ceramic surfaces were also marred by 'parting lines' caused by mold separation. This adversely affected the aerodynamic surface quality of the model as well. (Parting lines are invariably necessary on or near the leading edges of wings, nosetips, and fins for mold separation. These areas are also critical for flow boundary layer control.) Parting agents used in the casting process also affected surface quality. These agents eventually soaked into the mold, the model, or flaked off when releasing the case model. Different materials were tried, such as oils, paraffin, and even an algae. The algae released best, but some of it remained on the model and imparted an uneven texture and discoloration on the model surface when cured. According to the present invention, a wax pattern for a shell mold is provided, and an aqueous mixture of a calcium sulfate-bonded investment material is applied as a coating to the wax pattern. The coated wax pattern is then dried, followed by curing to vaporize the wax pattern and leave a shell mold of the calcium sulfate-bonded investment material. The shell mold is cooled to room temperature, and a ceramic slip is poured therein. After a ceramic shell of desired thickness has set up in the shell mold, excess ceramic slip is poured out. While still wet, the shell mold is peeled from the ceramic shell to expose any delicate or detailed parts, after which the ceramic shell is cured to provide a complete, detailed, precision ceramic article without parting lines.

Official Gazette of the U.S. Patent and Trademark Office

**N94-20551#** Southwest Research Inst., San Antonio, TX. Fuels and Lubricants Research Facility.

**COMPATIBILITY AND EFFICACY OF BIOCIDES QUALIFIED UNDER MILITARY SPECIFICATION MIL-S-53021 Interim Report, Oct. 1992 - Aug. 1993**

S. R. WESTBROOK and M. L. ALEXANDER Sep. 1993 24 p (Contract DAAK70-92-C-0059; DA PROJ. 1L2-63001-D-150)

(AD-A271496; BFLRF-282) Avail: CASI HC A03/MF A01

The Army has three fuel biocides qualified under specification MIL-S-53021. The military's aviation kerosene, JP-8, also contains an icing inhibitor additive that has some biocidal activity. The relative effectiveness and compatibility of these additives have never been

investigated. This study was conducted to evaluate the efficacy of the individual biocides as well as the possible interactions (either synergistic or antagonistic) between these biocides and the icing inhibitor additive. Each of the qualified biocides was evaluated using standard microbiological techniques to determine additive efficacy and compatibility with other fuel additives. The relative effectiveness of the qualified additives was determined. The interactions of the biocides with the icing inhibitor additive in JP-8 were also investigated. DTIC

**N94-21143** Garrett Turbine Engine Co., Phoenix, AZ.

**OXIDATION RESISTANT PROTECTIVE COATING SYSTEM FOR GAS TURBINE COMPONENTS AND PROCESS FOR PENETRATION THEREOF Patent**

THOMAS E. STRANGMAN, inventor (to Garrett Turbine Engine Co.) and STEVEN J. VONK, inventor (to Garrett Turbine Engine Co.) 14 Jan. 1992 34 p Filed 24 Feb. 1987

(CA-PATENT-1,294,155; INT-PATENT-CLASS-C23C-30/00;

INT-PATENT-CLASS-C22C-19/05;

INT-PATENT-CLASS-B32B-15/01; CTN-93-60672) Copyright

Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC/MF

An oxidation resistant coating system is provided for the protection of superalloy gas turbine components. The chemistry of the coating is modified from that of prior coatings to increase the adherence of the protective oxide scale and to increase the strength and diffusional stability of the coating, while maintaining adequate resistance to corrosion by ingested salts. The coating and substrate material may be optimized to provide increased performance and operating life of the gas turbine. The coating of the invention consists essentially of ingredients in substantially the following ranges, expressed in weight percent: Cr, 15-35; Al, 8-20; Ta, 0-10; Ta + Nb, 0-10; Si, 0.1-1.5; Hf, 0.1-1.5; Y, 0-1; Co, 0-10; and sufficient Ni to bring the total to 100 percent. Most preferably, a coating designed to protect superalloy turbine blades and vanes such as single crystal components consists essentially of ingredients in about the following amounts, in weight percent: Cr, 20; Al, 11; Ta, 7; Hf, 1; Si, 1; Nb, Si, and Y, zero to trace amounts; and the balance being Ni. The coatings can be applied to the substrates by any convenient means which minimizes oxidation or other degradation of the coating during application. Preferably the coating is applied as an overlay, for example by plasma spraying, electron beam deposition, or sputtering.

Author (CISTI)

**N94-21165#** Florida Univ., Gainesville.

**A PROPOSED METHODOLOGY FOR COMBUSTION TOXICOLOGY TESTING OF COMBINED HALON REPLACEMENT AGENT/JET FUEL INTERACTION Final Report, Jun. - Sep. 1991**

CHARLES J. KIBERT Apr. 1993 67 p

(Contract AF PROJ. 6302)

(AD-A272695; AL/OET-TR-1993-0047) Avail: CASI HC A04/MF A01

An international consensus to remove chlorofluorocarbon (CFC) compounds from production and U.S. national policy to implement the resulting protocols has motivated the U.S. Air Force to embark on a program to find a suitable replacement for Halon 1211, currently used to extinguish flight line fires. This research addressed the feasibility of conducting a combustion toxicology (CT) program to assess the toxic products of the combustion interaction of JP-8 and the Group 1 or so-called Near Term candidate replacement agents for Halon 1211: HCFC's -123, -124, and -142b. A laboratory scale experiment benchmarked on large scale testing of a 150 sq ft pool fire was developed on the basis of Froude scaling of the full scale fire to a 15 x 15 cm pan fire. A prototype apparatus was developed and investigation into the use of animal behavior methods as an indicator of human incapacitation was conducted. The result is a new method which may potentially be utilized for future toxicity studies of the combustion interaction of current and future U.S. Air Force fuels with various fire extinguishants. DTIC

## ENGINEERING

**N94-21822#** Oak Ridge National Lab., TN.  
**CERAMIC TECHNOLOGY PROJECT Semiannual Progress Report, Apr. - Sep. 1992**

D. R. JOHNSON Jul. 1993 442 p

(Contract DE-AC05-84OR-21400)

(DE94-001011; ORNL/TM-12363) Avail: CASI HC A19/MF A04

This project was developed to meet the ceramic technology requirements of the DOE Office of Transportation Systems' automotive technology programs. Significant progress in fabricating ceramic components for DOE, NASA, and DOE advanced heat engine programs show that operation of ceramic parts in high-temperature engines is feasible; however, additional research is needed in materials and processing, design, and data base and life prediction before industry will have a sufficient technology base for producing reliable cost-effective ceramic engine components commercially. A 5-year project plan was developed, with focus on structural ceramics for advanced gas turbine and diesel engines, ceramic bearings and attachments, and ceramic coatings for thermal barrier and wear applications in these engines. DOE

**N94-22601#** Deutsche Airbus G.m.b.H., Bremen (Germany).  
**EXPERIMENTS WITH A FLUID DEICING SYSTEM FOR CLEANING LAMINAR WINGS [EXPERIMENTE MIT EINEM FLUIDISCHEN ENTEISUNGSSYSTEM ZUR SAEUBERUNG VON LAMINARFLUEGELN]**

R. HENKE *In* Tech. Univ. Berlin, Measurement Technology for Flight Tests p 35-56 May 1991. *In* GERMAN

Avail: CASI HC A03/MF A02

The capability of a fluid deicing system for transonic laminar wing cleaning is tested with the ATTAS research aircraft. The ATTAS is a twin jet regional airplane. A panel of the original, coarsely porous deicing system was exchanged for a specially produced titanium plate with laser drilled holes, which were regularly located on the surface; an equivalent surface was defined as a reference panel and searchlight was mounted between both panels. A standard deicing liquid, made of 80 percent water and 20 percent glycol, was tested as well as three other liquids, with different additives which modify the viscosity. Testing free parameters were adjustable liquid quantity, flight velocity, and liquid viscosity as a function of temperature. All flights took place in low altitudes in order to obtain statistical distribution of dirtiness. The cleanliness results were measured with digital image processing and the residual dirtiness was estimated with roughness measurements. The tests are found to be reproducible and easily automatable.

ESA

**N94-22622\*#** National Aeronautics and Space Administration.  
 Langley Research Center, Hampton, VA.

**DELAMINATION, DURABILITY, AND DAMAGE TOLERANCE OF LAMINATED COMPOSITE MATERIALS**

T. KEVIN OBRIEN *In* its Computational Methods for Failure Analysis and Life Prediction p 311-322 Oct. 1993

Avail: CASI HC A03/MF A03

Durability and damage tolerance may have different connotations to people from different industries and with different backgrounds. Damage tolerance always refers to a safety of flight issue where the structure must be able to sustain design limit loads in the presence of damage and return to base safely. Durability, on the other hand, is an economic issue where the structure must be able to survive a certain life under load before the initiation of observable damage. Delamination is typically the observable damage mechanism that is of concern for durability, and the growth and accumulation of delaminations through the laminate thickness is often the sequence of events that leads to failure and the loss of structural integrity. Author (revised)

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

**N94-20418\*#** National Aeronautics and Space Administration.  
 Langley Research Center, Hampton, VA.

**INTEGRATED DISPLAY OF MULTI-SENSOR GEOPHYSICAL AND ELECTROMAGNETIC FLIGHT DATA Abstract Only**

V. E. DELNORE (Lockheed Engineering and Sciences Co., Hampton, VA.), E. M. BRACALENTE, S. D. HARRAH, and C. L. BRITT, JR. (Research Triangle Inst., Hampton, VA.) *In* JPL, Progress In Electromagnetics Research Symposium (PIERS) p 259 1993

Avail: CASI HC A01/MF A10

Low-altitude wind shear has been identified by several aviation interests as a significant hazard to the safety of flying. The hazard may be greatest when the wind shear is due to an unpredicted and short-lived microburst occurring in the immediate flight path of an aircraft during takeoff or landing. Researchers from the NASA Langley Research Center have investigated wind shear by developing a suite of remote sensing instruments and then using these instruments in an airborne wind shear detection flight program. Among these instruments were a Doppler radar, a lidar, and an infrared sensor; these were supported by in situ measurements of aircraft and environmental parameters and by ground-based Doppler radars. The basic problem addressed was the airborne detection and measurement of meteorologically-induced wind shear sufficiently ahead of the aircraft to allow avoidance. If the remote measurements of the shear and its associated radar reflectivity did not exceed set limits, the airplane then continued through the wind shear so that in situ measurements could be made for comparison. Initial detection and vectoring to the wind shear was normally given from a ground-based Doppler weather radar and most of the wind shear events were due to microbursts, both wet and dry. This paper considers the problems of sampling the wind shear event, time and space registration among the various sensors, coordination of the various sensors' beams and sampling volumes, and also various techniques for portraying the data, both for research and for presentation. Examples are given based on data from the 1991 and 1992 NASA/FAA wind shear flights, and the results and conclusions are generalized to other flight experiments involving multi-sensor electromagnetic data sets. Author

**N94-20419\*#** National Aeronautics and Space Administration.  
 Langley Research Center, Hampton, VA.

**DESCRIPTION AND AVAILABILITY OF AIRBORNE DOPPLER RADAR DATA Abstract Only**

S. D. HARRAH, E. M. BRACALENTE, P. R. SCHAFFNER, and E. G. BAXA (Clemson Univ., SC.) *In* JPL, Progress In Electromagnetics Research Symposium (PIERS) p 262 1993

Avail: CASI HC A01/MF A10

An airborne, forward-looking, pulse, Doppler radar has been developed in conjunction with the joint FAA/NASA Wind Shear Program. This radar represents a first in an emerging technology. The radar was developed to assess the applicability of an airborne radar to detect low altitude hazardous wind shears for civil aviation applications. Such a radar must be capable of looking down into the ground clutter environment and extracting wind estimates from relatively low reflectivity weather targets. These weather targets often have reflectivities several orders of magnitude lower than the surrounding ground clutter. The NASA radar design incorporates numerous technological and engineering achievements in order to accomplish this task. The basic R/T unit evolved from a standard Collins 708 weather radar, which supports specific pulse widths of

1-7 microns and Pulse Repetition Frequencies (PRF) of less than 1-10 kHz. It was modified to allow for the output of the first IF signal, which fed a NASA developed receiver/detector subsystem. The NASA receiver incorporated a distributed, high-speed digital attenuator, producing a range bin to range bin automatic gain control system with 65 dB of dynamic range. Using group speed information supplied by the aircraft's navigation system, the radar signal is frequency demodulated back to base band (zero Doppler relative to stationary ground). The In-phase & Quadrature-phase (I/Q) components of the measured voltage signal are then digitized by a 12-bit A-D converter (producing an additional 36 dB of dynamic range). The raw I/Q signal for each range bin is then recorded (along with the current radar & aircraft state parameters) by a high-speed Kodak tape recorder. Author

**N94-20427\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**OBSERVATION OF PRESSURE RIDGES IN SAR IMAGES OF SEA ICE: SCATTERING THEORY AND COMPARISON WITH OBSERVATIONS Abstract Only**

J. F. VESECKY (Michigan Univ., Ann Arbor.), J. M. DAIDA (Michigan Univ., Ann Arbor.), R. A. SHUCHMAN (Environmental Research Inst. of Michigan, Ann Arbor.), R. H. ONSTOTT (Environmental Research Inst. of Michigan, Ann Arbor.), and J. C. CAMISO *In* JPL, Progress In Electromagnetics Research Symposium (PIERS) p 479 1993

Avail: CASI HC A01/MF A10

Ridges and keels (hummocks and bummocks) in sea ice flows are important in sea ice research for both scientific and practical reasons. Sea ice movement and deformation is driven by internal and external stresses on the ice. Ridges and keels play important roles in both cases because they determine the external wind and current stresses via drag coefficients. For example, the drag coefficient over sea ice can vary by a factor of several depending on the fluid mechanical roughness length of the surface. This roughness length is thought to be strongly dependent on the ridge structures present. Thus, variations in ridge and keel structure can cause gradients in external stresses which must be balanced by internal stresses and possibly fracture of the ice. Ridging in sea ice is also a sign of fracture. In a practical sense, large ridges form the biggest impediment to surface travel over the ice or penetration through sea ice by ice-strengthened ships. Ridges also play an important role in the damage caused by sea ice to off-shore structures. Hence, observation and measurement of sea ice ridges is an important component of sea ice remote sensing. The research reported here builds on previous work, estimating the characteristics of ridges and leads in sea ice from SAR images. Our objective is to develop methods for quantitative measurement of sea ice ridges from SAR images. To make further progress, in particular, to estimate ridge height, a scattering model for ridges is needed. Our research approach for a ridge scattering model begins with a survey of the geometrical properties of ridges and a comparison with the characteristics of the surrounding ice. For this purpose we have used airborne optical laser (AOL) data collected during the 1987 Greenland Sea Experiment. These data were used to generate a spatial wavenumber spectrum for height variance for a typical ridge - the typical ridge is the average over 10 large ridges. Our first-order model radar scattering includes both the quasi-specular and Bragg resonant scatter mechanisms. This model is extended to include contributions from volume scatter and scatter from discrete objects. Geometrical characteristics from the AOL survey and model calculations imply that for radar wavelengths and observation geometries that are dominated by the quasi-specular scattering mechanism radar backscatter from a ridge is a measure of peak ridge height. We present scattering model results and compare them with ridges observed during the LEADEx experiment of March-April 1992 when both X, C, and L-band aircraft SAR and the ERS-1 satellite SAR observed a region in the Beaufort Sea near 86 deg N, 10 deg W. Data were also collected documenting ridge characteristics on the surface. The surface data are used to generate a SAR signature via the scattering model described above. The predicted SAR signatures compare well with the SAR observations. Author

**N94-20458\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**MOBILE TERMINAL ANTENNAS FOR HELICOPTERS Abstract Only**

TE-KAO WU, K. FARAZIAN, N. GOLSHAN, D. DIVSALAR, S. HINEDI, and K. WOO *In* its Progress In Electromagnetics Research Symposium (PIERS) p 885 1993

Avail: CASI HC A01/MF A10

In this paper, the feasibility of using an L-band low gain antenna (LGA) as a mobile terminal antenna for helicopters is described. The objective is to select the lowest cost antenna system which can be easily mounted on a helicopter and capable of communicating with a geosynchronous satellite. To ensure that all the antenna options are being considered, the steerable high gain reflector and medium gain array antennas as well as LGA are studied and compared in an exhaustive survey. The high gain reflector antenna in L-band is usually very large in size and heavy in weight. In addition, a bulky and expensive tracking system is needed to steer the antenna beam to the satellite direction. The medium gain antennas (including mechanically and electronically steered arrays) are also more expensive and less reliable than an LGA due to the addition of a beam steering system to track the satellite. The omni-directional LGA is simple, reliable, and inexpensive. It is typically ten times smaller than the medium gain antenna. This makes the position, selection, and mounting on the helicopter relatively easier. Therefore, the LGA is selected as a mobile terminal antenna for helicopters. Among the many LGA's (cross-dipole, helix, spiral, and slot antennas), the helix antenna is the most inexpensive. One can also change the size, shape, or pitch angle of the helix to optimize the gain in the desired direction. Therefore, the helix antenna is selected for further study. Both 2-arm and 4-arm helices are studied theoretically and experimentally to determine the antenna's performance and the scattering effects from the helicopter body and the blades. The multipath, Doppler, and Doppler rate issues as well as the periodic fading effects caused by the helicopter rotor blades will be briefly discussed in the paper. Author (revised)

**N94-20567** Advanced Materials, Inc., Metairie, LA.

**COLD-START MINIDIESEL ENGINE DEVELOPMENT Final**

Report, Jul. 1991 - Mar. 1992

CONRAD COLLINS Sep. 1993 32 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(Contract DAAK60-91-C-0093; DA PROJ. 1L1-62786-AH-98)

(AD-A271064; NATICK-TR-93/039) Avail: CASI HC A03

Military mission performance in a chemically contaminated environment necessitates the wearing of chemically impermeable protective garments. Soldiers encapsulated in these protective garments will succumb to heat stress in a hot environment. Consequently, a microclimate cooling system is being developed. In the design, a vapor compression cycle chills water which is then circulated over the body to absorb heat via a cooling garment. The engine, the prime mover in the system, is a major component. Commercially available engines of approximately 0.5 hp at 4000 rpm, the required size, include model aircraft engines and small outdoor power equipment (string trimmer) engines. However, these engines do not run on JP-8 or diesel fuel, a requirement for military use. Design, evaluation, and results of three engines are detailed. These include: the potential of a high compression, carbureted, glow plug engine operating on diesel fuel; the potential of a high compression, spark assist, fuel injected engine operating on diesel fuel; and a true high compression, fuel injected engine operating on diesel fuel. DTIC

**N94-20588\*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**SYSTEM AND METHOD FOR CANCELLING EXPANSION WAVES IN A WAVE ROTOR Patent**

DANIEL E. PAXSON, inventor (to NASA) 7 Dec. 1993 9 p Filed 26 May 1992 Supersedes N93-11172 (31 - 2, p 297) (NASA-CASE-LEW-15218-1; US-PATENT-5,267,432;

US-PATENT-APPL-SN-889003; US-PATENT-CLASS-60-39.45;  
US-PATENT-CLASS-417-64; INT-PATENT-CLASS-F02C-3/02)  
Avail: US Patent and Trademark Office

A wave rotor system that is comprised of a wave rotor coupled to first and second plates is described. Special ports are provided, one in each of the first and second end plates, to cancel expansion waves generated by the release of working fluid from the wave rotor. One of the expansion waves is reflected in the wave rotor from a reflecting portion and provided to the special port in the second end plate. Fluid present at the special port in the second end plate has a stagnation pressure and mass flow which is the same as that of the cells of the wave rotor communicating with such special port. This allows for cancellation of the expansion wave generated by the release of working fluid from the wave rotor. The special port in the second end plate has a first end corresponding to the head of the expansion wave and a second end corresponding to the tail of the expansion wave. Also, the special port is configured to continually change along the circumference of the second end plate to affect expansion wave cancellation. An expansion wave generated by a second release of working fluid from the wave rotor is cancelled in a similar manner to that described above using a special port in the first end plate. The cycle of operation of the wave rotor system is designed so that the stagnation pressure and mass flow of the fluid present at the special ports is the same so that the special ports may be connected by a common duct.

Official Gazette of the U.S. Patent and Trademark Office

**N94-20595#** Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides et d'Acoustique.

**TWO DIMENSIONAL SIMULATION OF THE ELECTRIC ARC BEHAVIOR IN A CUT-OFF DEVICE Ph.D. Thesis [SIMULATION BIDIMENSIONNELLE DU COMPORTEMENT D'UN ARC ELECTRIQUE DANS UN APPAREIL DE COUPURE]**

PHILIPPE ROBIN-JOUAN 1992 189 p In FRENCH Original contains color illustrations  
(ECL-92-41; ETN-93-94597) Avail: CASI HC A09/MF A02

The current cutoff in an electric circuit is followed by an electric arc between the contacts. The conducting media contains high intensity heat sources which induce very high temperature regions limited by boundaries of large temperature differences. Experimental tests are very hard to carry out under these conditions and simulations are needed. In order to perform the aerothermodynamic modeling, the dynamic, thermal, radiative, and electric effects have to be taken into account. A two dimensional calculation is performed by using parameters due to the influence of the wall at the horizontal surface between both electrodes. A thermal approach was applied and the importance of radiative parameters was stressed. The modeling of an electric arc was possible only for very short time delays and their strong dependence on magnetic forces was evidenced. Different front shapes, related to the structures of flow which form vortices, were characterized. ESA

**N94-21201#** Federal Aviation Administration, Oklahoma City, OK. Civil Aeromedical Inst.

**ATC/PILOT VOICE COMMUNICATIONS: A SURVEY OF THE LITERATURE Final Report**

O. VERONIKA PRINZO and THOMAS W. BRITTON Nov. 1993 38 p  
(DOT/FAA/AM-93/20) Avail: CASI HC A03/MF A01

The first radio-equipped control tower in the United States opened at the Cleveland Municipal Airport in 1930. From that time to the present, voice radio communications have played a primary role in air safety. Verbal communications in air traffic control (ATC) operations have been frequently cited as causal factors in operational errors and pilot deviations in the FAA Operational Error and Deviation System, the NASA Aviation Safety Reporting System (ASRS), and reports derived from government sponsored research projects. Collectively, the data provided by these programs indicate that communications constitute a significant problem for pilots and controllers. Although the communications problem was well known the research literature was fragmented, making it difficult to

appreciate the various types of verbal communications problems that existed and their unique influence on the quality of ATC/pilot communications. This is a survey of the voice radio communications literature. The 43 reports in the review represent survey data, field studies, laboratory studies, narrative reports, and reviews. The survey topics pertain to communications taxonomies, acoustical correlates and cognitive/psycholinguistic perspectives. Communications taxonomies were used to identify the frequency and types of information that constitute routine communications, as well as those communications involved in operational errors, pilot deviations, and other safety-related events. Acoustical correlate methodologies identified some qualities of a speaker's voice, such as loudness, pitch, and speech rate, which might be used potentially to monitor stress, mental workload, and other forms of psychological or physiological factors that affect performance. Cognitive/psycho-linguistic research offered an information processing perspective for understanding how pilots' and controllers' memory and language comprehension processes affect their ability to communicate effectively with one another. This analysis of the ATC/pilot voice radio communications literature was performed to provide an organized summary for the systematic study of interactive communications between controllers and pilots. Recommendations are given for new research initiatives, communications-based instructional materials, and human factors applications for new communications systems. Author

**N94-21253#** Environmental Research Inst. of Michigan, Ann Arbor.

**LONG-RANGE LASER IMAGING Final Report, Jan. - Jul. 1993**

JOSEPH C. MARRON and RICHARD G. PAXMAN 30 Sep. 1993 63 p

(Contract DLA900-88-D-0392)

(AD-A273020; ERIM-246830-9-F) Avail: CASI HC A04/MF A01

This report summarizes a research program in which we evaluated the use of a Long-Range Laser Imaging (LRLI) system to perform the imaging tasks associated with laser target designation. The motivation for LRLI is to improve crew and aircraft survivability by increasing the standoff range and reducing the required time interval for air-based laser target designation. In this program, we analyzed the capabilities of LRLI systems. We considered the signal level and its impact on sensor field-of-view. This analysis includes laser selection, atmospheric transmission, target reflectivity, and optical system characteristics. It is shown that the laser signal level ultimately limits the number of target pixels. It is also shown that a pulsed system is required for background rejection. The impact of optical turbulence on system performance is also discussed. We evaluated the achievable resolution and considered the use of adaptive optics. It is shown, however, that severe anisoplanatism limits the utility of adaptive optics. We conclude that the most promising sensor design is based on conventional imaging and recommendations for proof-of-concept experiments are given. DTIC

**N94-21284#** Science Research Lab., Inc., Somerville, MA.

**COMPACT LIGHTWEIGHT CO2 LASER FOR SDIO**

**APPLICATION Final Report, 1 Jul. 1990 - 30 Jun. 1992**

STEPHEN FULGHUM and JONAH JACOB 15 Nov. 1993 50 p  
(Contract N00014-90-C-0162)

(AD-A273010; SRL-12-F-1993) Avail: CASI HC A03/MF A01

SRL has combined two all-solid-state pulsed power generators based on SCR-commutated nonlinear magnetic pulse compressors with low-pressure, conduction-cooled, CO2 laser cavities in a program to produce high repetition rate laser systems without the weight penalty of flow loop cooling. The first CO2 system used a transverse discharge, rectangular slab geometry, laser amplifier matched to the 10 Hz, SRL COLD-I solid-state pulser. Visible interferometric probes of the slab geometry laser medium showed the characteristic cylindrical wavefront error expected of a uniformly heated slab cooled at its walls. Conduction cooling of the 2.4 cm slab was sufficient to dissipate the thermal energy deposited by a single pulse dissipated to below the measurement level within 100 ms (10 Hz). The second CO2 system used a longitudinal discharge, cylindrical geometry, laser amplifier combined with the



new SSLAM-VIII pulser which produces 72 KV, 30 J pulses at up to 5 KHz. The longitudinal laser output power typically peaked at 50 Hz since the heat load from higher repetition rates could not be dissipated sufficiently rapidly from the 4 cm diameter discharge. Due to an impedance mismatch the maximum single pulse energy in steady state operation was 350 mJ (18 W average power). A circuit to provide proper matching has been designed but has not yet been implemented. DTIC

**N94-21607\*#** Physical Sciences, Inc., Andover, MA.  
**INSTANTANEOUS VELOCITY FIELD IMAGING INSTRUMENT FOR SUPERANEOS REACTING FLOWS Final Report**  
 M. G. ALLEN, S. J. DAVIS, W. J. KESSLER, H. H. LEGNER, K. R. MCMANUS, P. A. MULHALL, T. E. PARKER, and D. M. SONNENFROH Cleveland, OH NASA Sep. 1993 101 p  
 Original contains color illustrations  
 (Contract NAS3-26254; RTOP 324-02-00)  
 (NASA-CR-191162; E-8131; NAS 1.26:191162) Avail: CASI HC A06/MF A02; 2 functional color pages

The technical tasks conducted to develop and demonstrate a new gas velocity measurement technique for high enthalpy reacting flows is described. The technique is based on Doppler-shifted Planar Laser-induced Fluorescence (PLIF) imaging of the OH radical. The imaging approach permits, in principle, single-shot measurements of the 2-D distribution of a single velocity component in the measurement plane, and is thus a technique of choice for applications in high enthalpy transient flow facilities. In contrast to previous work in this area, the present program demonstrated an approach which modified the diagnostic technique to function under the constraints of practical flow conditions of engineering interest, rather than vice-versa. In order to accomplish the experimental demonstrations, the state-of-the-art in PLIF diagnostic techniques was advanced in several ways. Each of these tasks is described in detail and is intended to serve as a reference in supporting the transition of this new capability to the fielded PLIF instruments now installed at several national test facilities. Among the new results of general interest in LIF-based flow diagnostics, a detailed set of the first measurements of the collisional broadening and shifting behavior of OH (1,0) band transitions in H7-air combustion environments is included. Such measurements are critical in the design of a successful strategy for PLIF velocity imaging; they also relate to accurate concentration and temperature measurements, particularly in compressible flow regimes. Furthermore, the results shed new light on the fundamental relationship between broadening and energy transfer collisions in OH  $A(\text{sup } 2)\Sigma^+(+)v(\text{sup } ) = 1$ . The first single-pulse, spectrally-resolved measurements of the output of common pulsed dye lasers were also produced during the course of this effort. As with the OH broadening measurements, these data are a significant aspect of a successful velocity imaging strategy, and also have potential implications for many other LIF measurement techniques. Our results indicated the need to modify the commercially available laser cavity in order to accommodate the constraints imposed by typical SCRAMJET combustion characteristics as well as to increase the instrument's velocity dynamic range to span an intra-image range in excess of 2 km/s. The various technical efforts were brought together in a series of experiments demonstrating the applicability of the technique in a high pressure, high temperature H2-air combustion system. The resultant images were compared with 2-D flow simulations in order to determine the accuracy of the instrument. Mean velocity imaging in flows with an axis of symmetry was demonstrated with an accuracy of  $\pm 50$  m/s out of an intra-image dynamic range of 1600 m/s, including reversed flow. A more complex configuration amenable to single-shot imaging in flows without an axis of symmetry was also demonstrated. Limitations imposed by available equipment resulted in an accuracy of about  $\pm 200$  m/s out of 1750 m/s in these demonstrations. Minor modifications to the present configuration were suggested to improve this performance. Each technical task is described in detail, along with significance of the results for the overall imaging velocimeter configuration. This report should allow the user community to integrate this new measurement capability in their existing instrumentation platforms. Author (revised)

**N94-21620#** Lawrence Livermore National Lab., CA.  
**ELECTROMECHANICAL BATTERY RESEARCH AND DEVELOPMENT AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY**

R. F. POST, D. E. BALDWIN, D. A. BENDER, and T. K. FOWLER  
 Jun. 1993 9 p Presented at the Conference on Zero Emission Vehicles: the Electric Hybrid and Alternative Fuels Challenge, Aachen, Germany, 13-17 Sep. 1993  
 (Contract W-7405-ENG-48)  
 (DE93-019159; UCRL-JC-113905; CONF-930964-1) Avail: CASI HC A02/MF A01

The concepts undergirding a funded program to develop a modular electromechanical battery (EMB) at the Lawrence Livermore National Laboratory are described. Example parameters for EMB's for electric and hybrid-electric vehicles are given, and the importance of the high energy recovery efficiency of EMB's in increasing vehicle range in urban driving is shown. DOE

**N94-21621#** Lawrence Livermore National Lab., CA.  
**ELECTROMECHANICAL BATTERY RESEARCH AND DEVELOPMENT AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY**

R. F. POST, D. E. BALDWIN, D. A. BENDER, and T. K. FOWLER  
 17 Jun. 1993 14 p Presented at the Project Energy 1993 Conference, Kansas City, MO, 21-23 Jun. 1993  
 (Contract W-7405-ENG-48)  
 (DE94-000391; UCRL-JC-113905-REV-1;  
 CONF-9306204-2-REV-1) Avail: CASI HC A03/MF A01

New materials and new design concepts are being incorporated in a new approach to an old idea - flywheel energy storage - to create an important alternative to the electrochemical storage battery for use in electric vehicles or for stationary applications, such as computer back-up power or utility load-leveling. DOE

**N94-21756\*#** National Aeronautics and Space Administration.  
 Lewis Research Center, Cleveland, OH.

**THE RELATIVE NOISE LEVELS OF PARALLEL AXIS GEAR SETS WITH VARIOUS CONTACT RATIOS AND GEAR TOOTH FORMS**

RAYMOND J. DRAGO (Boeing Helicopter Co., Philadelphia, PA.), JOSEPH W. LENSKE, JR. (Boeing Helicopter Co., Philadelphia, PA.), ROBERT H. SPENCER (Boeing Helicopter Co., Philadelphia, PA.), MARK VALCO (Army Research Lab., Cleveland, OH.), and FRED B. OSWALD Dec. 1993 17 p Presented at the Fall Technical Meeting of the American Gear Manufacturers Association, Detroit, MI, 14-15 Oct. 1993  
 (Contract DA PROJ. 1L1-6211-A-47-A; RTOP 505-62-10)  
 (NASA-TM-106431; E-8273; NAS 1.15:106431; ARL-TR-318)  
 Avail: CASI HC A03/MF A01

The real noise reduction benefits which may be obtained through the use of one gear tooth form as compared to another is an important design parameter for any geared system, especially for helicopters in which both weight and reliability are very important factors. This paper describes the design and testing of nine sets of gears which are as identical as possible except for their basic tooth geometry. Noise measurements were made at various combinations of load and speed for each gear set so that direct comparisons could be made. The resultant data was analyzed so that valid conclusions could be drawn and interpreted for design use. Author

**N94-21757\*#** National Aeronautics and Space Administration.  
 Lewis Research Center, Cleveland, OH.

**PROBABILISTIC ASSESSMENT OF COMPOSITE STRUCTURES**

MICHAEL E. SHIAO (Sverdrup Technology, Inc., Brook Park, OH.), GALIB H. ABUMERI (Sverdrup Technology, Inc., Brook Park, OH.), and CHRISTOS C. CHAMIS Dec. 1993 17 p Presented at the 34th Structures, Structural Dynamics and Materials Conference, La Jolla, CA, 19-23 Apr. 1993; sponsored by AIAA, ASME, ASCE, AHS, and ASC See also A93-33990  
 (Contract RTOP 510-02-12)  
 (NASA-TM-106368; E-8173; NAS 1.15:106368) Avail: CASI HC A03/MF A01

A general computational simulation methodology for an integrated probabilistic assessment of composite structures is discussed and demonstrated using aircraft fuselage (stiffened composite cylindrical shell) structures with rectangular cutouts. The computational simulation was performed for the probabilistic assessment of the structural behavior including buckling loads, vibration frequencies, global displacements, and local stresses. The scatter in the structural response is simulated based on the inherent uncertainties in the primitive (independent random) variables at the fiber matrix constituent, ply, laminate, and structural scales that describe the composite structures. The effect of uncertainties due to fabrication process variables such as fiber volume ratio, void volume ratio, ply orientation, and ply thickness is also included. The methodology has been embedded in the computer code IPACS (Integrated Probabilistic Assessment of Composite Structures). In addition to the simulated scatter, the IPACS code also calculates the sensitivity of the composite structural behavior to all the primitive variables that influence the structural behavior. This information is useful for assessing reliability and providing guidance for improvement. The results from the probabilistic assessment for the composite structure with rectangular cutouts indicate that the uncertainty in the longitudinal ply stress is mainly caused by the uncertainty in the laminate thickness, and the large overlap of the scatter in the first four buckling loads implies that the buckling mode shape for a specific buckling load can be either of the four modes. Author (revised)

**N94-21791\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

#### **BRUSH SEAL BRISTLE FLEXURE AND HARD-RUB CHARACTERISTICS**

ROBERT C. HENDRICKS, JULIE A. CARLILE, and ANITA D. LIANG *In its* The 1992 Seals Flow Code Development Workshop p 95-115 Oct. 1993

Avail: CASI HC A03/MF A03

The bristles of a 38.1-mm (1.5-in.) diameter brush seal were flexed by a tapered, 40-tooth rotor operating at 2600 rpm that provided sharp leading-edge impact of the bristles with hard rubbing of the rotor lands. Three separate tests were run with the same brush accumulating over  $1.3 \times 10^6$  (exp 9) flexure cycles while deteriorating 0.2 mm (0.008 in.) radially. In each, the test bristle incursion depth varied from 0.130 to 0.025 mm (0.005 to 0.001 in.) or less (start to stop), and in the third test the rotor was set 0.25 mm (0.010 in.) eccentric. Runout varied from 0.025 to 0.076 mm (0.001 to 0.003 in.) radially. The bristles wore but did not pull out, fracture, or fragment. Bristle and rotor wear debris were deposited as very fine, nearly amorphous, highly porous materials at the rotor groove leading edges and within the rotor grooves. The land leading edges showed irregular wear and the beginning of a convergent groove that exhibited sharp, detailed wear at the land trailing edges. Surface grooving, burnishing, 'whipping', and hot spots and streaks were found. With a smooth-plug rotor, post-test leakage increased 30 percent over pretest leakage.

Author

**N94-21792\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

#### **INTEGRITY TESTING OF BRUSH SEAL IN A T-700 ENGINE**

ROBERT C. HENDRICKS, THOMAS A. GRIFFIN, GEORGE A. BOBULA, ROBERT C. BILL, and HAROLD W. HOWE (Technetics, Inc., DeLand, FL.) *In its* The 1992 Seals Flow Code Development Workshop p 117-138 Oct. 1993

Avail: CASI HC A03/MF A03

A split-ring brush seal was fabricated, installed between two labyrinth-honeycomb shroud seals, and tested in the fourth-stage turbine of a T-700 engine. The annealed Haynes 25 bristles rubbed directly against the nonconditioned, irregular Rene 80 turbine blade shroud surface. A total of 21 hr of cyclic and steady-state data were taken with surface speeds of 335 m/s (1100 ft/s) and shroud temperatures to 620 C (1150 F). Wear appeared to be rapid initially, with an orange flash of hot brush fragments during the first engine startup, to minimal after 10 hr of operation. The brush survived the testing but experienced some bristle pullouts and severe bristle

wear; some turbine interface wear and possible material transfer was noted. Future design concerns center on tribological behavior at the interface with or without lubricants. Author

**N94-21793\*#** Air Force Systems Command, Wright-Patterson AFB, OH. Aero Propulsion and Power Directorate.

#### **AIR FORCE BRUSH SEAL PROGRAMS**

CONNIE DOWLER *In* NASA. Lewis Research Center, The 1992 Seals Flow Code Development Workshop p 149-156 Oct. 1993  
Avail: CASI HC A02/MF A03

Aggressive pursuit of increased performance in gas turbine engines is driving the thermodynamic cycle to higher pressure ratios, bypass ratios, and turbine inlet temperatures. As these parameters increase, internal air system and resultant thermodynamic cycle losses increase. This conflict of reducing internal airflows while increasing thermodynamic efficiency and performance is putting more emphasis on improvements to the internal flow system. One improvement that has been and continues to be pursued by the Air Force for both man-rated and expendable turbine engine applications is the brush seal. This presentation briefly describes both past and current brush seal research and development programs and gives a summary of demonstrator and developmental engine testing of brush seals. Author

**N94-21794\*#** Naval Air Warfare Center, Trenton, NJ. Aircraft Div.

#### **NAVY GTE SEAL DEVELOPMENT ACTIVITY**

CARL P. GRALA *In* NASA. Lewis Research Center, The 1992 Seals Flow Code Development Workshop p 157-165 Oct. 1993  
Avail: CASI HC A02/MF A03

Under the auspices of the Integrated High Performance Turbine Engine Technology Initiative, the Naval Air Warfare Center conducts advanced development programs for demonstration in the next generation of air-breathing propulsion systems. Among the target technologies are gas path and lube oil seals. Two development efforts currently being managed by NAWCAD are the High Performance Compressor Discharge Film-Riding Face Seal and the Subsonic Core High Speed Air/Oil Seal. The High Performance Compressor Discharge Film-Riding Face Seal Program aims at reducing parasitic leakage through application of a film-riding face seal concept to the compressor discharge location of a Phase 2 IHPTET engine. An order-of-magnitude leakage reduction relative to current labyrinth seal configurations is expected. Performance goals for these seals are (1) 1200 F air temperature, (2) 800 feet-per-second surface velocity, and (3) 600 SPI differential pressure. The two designs chosen for fabrication and rig test are a spiral groove and a Rayleigh step seal. Rig testing is currently underway. The Subsonic Core High Speed Air/Oil Seal Program is developing shaft-to-ground seals for next-generation propulsion systems that will minimize leakage and provide full life. Significantly higher rotor speeds and temperatures will be experienced. Technologies being exploited include, hydrodynamic lift assist features, ultra light weight designs, and improved cooling schemes. Parametric testing has been completed; a final seal design is entering the endurance test phase. Author

**N94-21795\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

#### **COMPLIANT SEAL DEVELOPMENT**

ROBERT C. HENDRICKS *In its* The 1992 Seals Flow Code Development Workshop p 171-173 Oct. 1993

Avail: CASI HC A01/MF A03

The compliant metallic seal combines the noncontact feature of the labyrinth seal, the low leakage of a mechanical seal, and the compliant nature of the brush seal. It consists of several thin metallic elements or leaves mounted within a ring which is press fit into the housing, and in form, sort of resembles a lip seal sections wiping the shaft. A second set of overlapping cover leaves are placed on top of the shaft riding leaves which reduces leakage and provides stiffness. The leaves can be straight or angle cut. The shaft riding fingers are designed with mismatched curvature to provide lift off similar to the Rayleigh lift pads in mechanical seals with leading edge clearances nearly twice those of the trailing



edge as shown by Fleming to be optimal for gas flows in convergent seal passages. Leading edge clearances range from 300 to 500 microinches. Balance pockets beneath the leaves provide fluid film feed to the 'Rayleigh lift' surface and the proper balance ratio (mechanical seal) when combined with the static pressure and film pressure. The leaves flex in the radial direction and accommodate thermomechanical behavior as well as axial motion and angular misalignment. In the static mode, there is a net closing force on the leaves. The seals were tested to 70 psi at speeds to 16,000 rpm or surface speeds to 330 fps and temperatures from ambient to 440 F. A slow cycle through the rig critical at 10,000 rpm induced a radial vibration response of 0.004 to 0.005 inch were accommodated by the seal. Preliminary performance data are encouraging demonstrating hydrodynamic liftoff and noncontacting operation at pressure and speeds typical of gas turbine engines. The leakage performance data are significantly better than commercial labyrinth and brush seals which should be expected as this design incorporates the features of the low leakage face or mechanical seal along with the flexibility of the brush configuration. Author

**N94-21797\*** # Columbia Univ., New York, NY. Dept. of Mechanical Engineering.

#### **MODELING BRISTLE LIFT-OFF IN IDEALIZED BRUSH SEAL CONFIGURATIONS**

VIJAY MODI In NASA. Lewis Research Center, The 1992 Seals Flow Code Development Workshop p 217-232 Oct. 1993  
Avail: CASI HC A03/MF A03

We attempt in this paper to develop a model for the flow through brush seals and determine their elastic behavior in order to predict the dependence of brush/journal clearance on geometry and operating conditions. Several idealizations regarding brush seal configuration, flow conditions, and elastic behavior are made in the analysis in order to determine closed form parametric dependence. This formulation assumes that there is no initial interference between the bristle tip and the rotor. Also, interbristle, bristle-backing plate, and bristle-rotor friction is neglected. The bristle bundle or the brush seal as it is alternately called is assumed homogeneous and isotropic on a macroscopic scale so that a physical property like permeability is uniform. The fluid is assumed to be homogeneous, incompressible, viscous, and flowing under steady conditions. A schematic of a brush seal is shown. If the nominal bristle-shaft interference is absent then under static conditions the bristles may deflect axially due to the imposed pressure differential. This axial deflection may create a clearance permitting leakage flow in excess of that which occurs through the porous matrix formed by the bristle bundles. Under dynamic conditions the Couette flow created by shaft motion could be strong enough to cause bristle deflection and once again a clearance may develop. The paper proposes a means to determine this clearance (or at least describe its parametric dependence on geometry and operating conditions) under static as well as dynamic conditions. Derived from text

**N94-21830** Oak Ridge National Lab., TN.

#### **OPERATION OF A TEST BED AXIAL-GAP BRUSHLESS DC ROTOR WITH A SUPERCONDUCTING STATOR**

J. W. MCKEEVER, C. W. SOHNS, S. W. SCHWENTERLY, R. W. YOUNG, SR., V. W. CAMPBELL, M. H. HICKEY, G. W. OTT, and J. M. BAILEY 1993 42 p Presented at the International Cryogenic Engineering and Materials Conference, Albuquerque, NM, 12-16 Jul. 1993 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract DE-AC05-84OR-21400) (DE93-019167; CONF-930703-21) Avail: CASI HC A03

A variable-speed axial-gap motor with a stator consisting of four liquid helium cooled superconducting electromagnets (two pole pairs) was built and proof tested up to 608 rpm in November 1990 as a tool for joint industry-laboratory evaluation of coils fabricated from high temperature oxide superconductors. A second rotor was fabricated with improved material, winding configuration, and wire type, and the drive system was modified to eliminate current spiking. The modified motor was characterized to design

speed, 188 rad/s (1800 rpm), to acquire a performance baseline for future comparison with that of high temperature superconducting (HTS) wire. As it becomes commercially available, HTS wire will replace the low temperature electromagnet wire in a stator modified to control wire temperatures between 4 K and 77 K. Measurements of the superconducting electromagnetic field and locked rotor torque as functions of cryocurrent and dc current through two phases of the rotor, respectively, provided data to estimate power that could be developed by the rotor. Back emf and parasitic mechanical and electromagnetic drag torques were measured as functions of angular velocity to calculate actual rotor power developed and to quantify losses, which reduce the motor's efficiency. A detailed measurement of motor power at design speed confirmed the developed power equation. When subsequently operated at the 33-A maximum available rotor current, the motor delivered 15.3 kW (20.5 hp) to the load. In a final test, the cryostat was operated at 2500 A, 200 A below its critical current. At rotor design current of 60 A and 2500 A stator current, the extrapolated developed power would be 44.2 kW (59.2 hp) with 94% efficiency. DOE

**N94-21886\*** # Michigan Univ., Ann Arbor. Radiation Lab.

#### **SCATTERING BY CAVITY-BACKED ANTENNAS ON A CIRCULAR CYLINDER**

LEO C. KEMPEL and JOHN L. VOLAKIS In its Radiation and Scattering from Printed Antennas on Cylindrically Conformal Platforms p 1-35 Jan. 1994  
Avail: CASI HC A03/MF A02

Conformal arrays are popular antennas for aircraft, spacecraft, and land vehicle platforms due to their inherent low weight and drag properties. However, to date there has been a dearth of rigorous analytical or numerical solutions to aid the designer. In fact, it has been common practice to use limited measurements and planar approximations in designing such non-planar antennas. The finite element-boundary integral method is extended to scattering by cavity-backed structures in an infinite, metallic cylinder. In particular, the formulation specifics such as weight functions, dyadic Green's function, implementation details and particular difficulties inherent to cylindrical structures are discussed. Special care is taken to ensure that the resulting computer program has low memory demand and minimal computational requirements. Scattering results are presented and validated as much as possible. Author (revised)

**N94-21887\*** # Michigan Univ., Ann Arbor. Radiation Lab.

#### **RADIATION BY CAVITY-BACKED ANTENNAS ON A CIRCULAR CYLINDER**

LEO C. KEMPEL, JOHN L. VOLAKIS, and RANDY SLIVA In its Radiation and Scattering from Printed Antennas on Cylindrically Conformal Platforms p 37-60 Jan. 1994  
Avail: CASI HC A03/MF A02

Conformal antenna arrays are popular antennas for aircraft, spacecraft and land vehicle platforms due to their inherent low weight, cost and drag properties. However, to date there has been a dearth of rigorous analytical or numerical solutions to aid the designer. In fact, it has been common practice to use limited measurements and planar approximations in designing such non-planar antennas. The finite element-boundary integral method is extended to radiation by cavity-backed structures in an infinite, metallic cylinder. The formulation is used to investigate the effect of cavity size on the radiation pattern for typical circumferentially and axially polarized patch antennas. Curvature effect on the gain, pattern shape, and input impedance is also studied. Finally, the accuracy of the FE-BI approach for a microstrip patch array is demonstrated. Author (revised)

**N94-21927\*** # Argonne National Lab., IL.

#### **A VIBRATION MODEL FOR CENTRIFUGAL CONTACTORS**

R. A. LEONARD, M. O. WASSERMAN, and D. G. WYGMANS Nov. 1992 84 p (Contract W-31-109-ENG-38) (DE93-040645; ANL-92/40) Avail: CASI HC A05/MF A01

Using the transfer matrix method, we created the Excel

worksheet 'Beam' for analyzing vibrations in centrifugal contactors. With this worksheet, a user can calculate the first natural frequency of the motor/rotor system for a centrifugal contactor. We determined a typical value for the bearing stiffness ( $k_{\text{sub B}}$ ) of a motor after measuring the  $k_{\text{sub B}}$  value for three different motors. The  $k_{\text{sub B}}$  value is an important parameter in this model, but it is not normally available for motors. The assumptions that we made in creating the Beam worksheet were verified by comparing the calculated results with those from a VAX computer program, BEAM IV. The Beam worksheet was applied to several contactor designs for which we have experimental data and found to work well.

DOE

**N94-21938#** Solar Turbines, Inc. San Diego, CA.  
**ADVANCED TURBINE SYSTEMS (ATS). PHASE 1: SYSTEM SCOPING AND FEASIBILITY STUDIES**

D. J. WHITE 15 Apr. 1993 11 p  
 (Contract DE-AC21-86MC-23166)  
 (DE93-041130; DOE/MC-23166/3414; SR-93-R-5278-115) Avail:  
 CASI HC A03/MF A01

As part of this involvement, Solar intends to design and commercialize a unique gas turbine system that promises high cycle efficiencies and low exhaust emissions. This engine of approximately 12-MW will be targeted for the dispersed power markets both urban and rural. Goals of 50% thermal efficiency and 8 parts-per-million by volume (ppmv) nitrogen oxide emissions were established. Reliability, availability, and maintainability (RAM) will continue to be the most important factors in the competitive marketplace. The other major goal adopted was one of reducing the cost of power produced by 10%. This reduction is based on the cost of power (COP) associated with today's engines that lie in the same horsepower range as that targeted in this study. An advanced cycle based on an approximation of the Ericsson Cycle was adopted after careful studies of a number of different cycles. This advanced intercooled, recuperated engine when fired at 2450 F will be capable of meeting the 50% efficiency goal if the cooling air requirements do not exceed 7% of the total air flow rate. This latter qualification will probably dictate the use of ceramic parts for both the nozzle guide vanes and the turbine blades. Cooling of these parts will probably be required and the 7% cooling flow allowance is thought to be adequate for such materials. Analyses of the cost of power and RAM goals show that the installed cost of this advanced engine can be approximately 50% above today's costs. This cost is based on \$4.00 per million Btu fuel and a COP reduction of 10% while maintaining the same RAM as today's engines.

DOE

**N94-21983#** Department of Energy, Morgantown, WV. Energy Technology Center.

**PERFORMANCE CALCULATIONS AND RESEARCH DIRECTION FOR A WATER ENHANCED REGENERATIVE GAS TURBINE CYCLE**

L. H. ROGERS and D. H. ARCHER (Carnegie-Mellon Univ., Pittsburgh, PA.) 1993 9 p Presented at the 28th Intersociety Energy Conversion Engineering Conference, Atlanta, GA, 8-13 Aug. 1993

(DE93-019866; DOE/METC-C/93/7097; CONF-930804-18)  
 Avail: CASI HC A02/MF A01

A cycle has been conceived that combines compressor cooling, humidification, and regenerative air heating with the added enhancement of direct injection of water into the air flow. In this cycle it is proposed that a fine mist of water be injected into the compressor air stream and a spray or film of water into the regenerator air stream. Water injection into the compressor air flow realizes several benefits: it cools the air flow, reducing the power required for compression and increasing the potential for exhaust heat recovery; it adds mass to the air stream, increasing the power produced by expansion; and it reduces the amount of cooling bleed air required by increasing the specific heat and decreasing the temperature of the cooling air stream. The greatest benefit would be derived from spraying a fine mist of water directly into the existing air flow into or before the compressor so that cooling and compression would occur simultaneously. This may

be accomplished by entraining the water droplets in the inlet air flow or by introducing the water in stages during compression. An alternative and less technically challenging approach is to extract the air stream to a saturation chamber and then reintroduce the air stream into the compressor. This approach is not as desirable because it would increase the equipment cost and add a significant pressure drop penalty. The second use of water in this cycle is in water-assisted regeneration. The heat capacity of the hot stream in regenerators is greater than the heat capacity of the cool stream because of the increased mass flow and specific heat of the combustion products. This imbalance leads to a less than ideal exhaust heat recovery since the cool air stream is unable to absorb all of the available heat. If water is injected into the cool stream in the regenerator, some of the available heat is used to vaporize the water, allowing additional heat recovery and also adding mass to the air flow. Also, the effectiveness of the heat exchanger can be increased, and the cost reduced, by injecting the water as early as possible in the flow, keeping the cool stream temperature low and thus maximizing the temperature difference across the regenerator.

DOE

**N94-22126** Concordia Univ., Montreal (Quebec). Dept. of Electrical and Computer Engineering.

**IMPROVEMENTS IN ANTENNA COUPLING PATH ALGORITHMS FOR AIRCRAFT EMC ANALYSIS**

MICHAEL BOGUSZ and STANLEY J. KIBINA /In Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 4 p 1991

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

The algorithms to calculate and display the path of maximum electromagnetic interference coupling along the perfectly conducting surface of a frustum cone model of an aircraft nose are developed and revised for the Aircraft Inter-Antenna Propagation with Graphics (AAPG) electromagnetic compatibility analysis code. Analysis of the coupling problem geometry on the frustum cone model and representative numerical test cases reveal how the revised algorithms are more accurate than their predecessors. These improvements in accuracy and their impact on realistic aircraft electromagnetic compatibility problems are outlined.

Author (CISTI)

**N94-22128** Concordia Univ., Montreal (Quebec). EMC Lab.

**RCS OF SHIPS AND AIRCRAFT AT HF FREQUENCIES**

C. W. TRUEMAN, S. J. KUBINA, S. R. MISHRA (Canadian Space Agency, Ottawa, Ontario.), and C. LAROSE (Canadian Space Agency, Ottawa, Ontario.) /In Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2 4 p 1991

Avail: Issuing Activity (Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, PQ H3A 1Z2 Canada)

Coastal radar operating at high frequency (HF) has the potential of monitoring iceberg movement and ship and aircraft traffic over a wide area of ocean. The HF radar cross-section of an aircraft-like scatterer of simple geometry is investigated. At these frequencies, the aircraft size is comparable to the wavelength. The aircraft radar cross-section (RCS) is obtained both by computation and by direct measurement. It is demonstrated that at low frequencies in the HF range, the dorsal fin is the dominant scatterer, but at high HF the fuselage can scatter more strongly than the dorsal fin. Aircraft often carry wire antennas for HF communication, and it is shown that such wires can dramatically alter the RCS of the aircraft near the resonant frequencies of the wire. The RCS of a ship modelled as a parallelepiped with mast is 20-30 decibels larger than that of an aircraft, and is dominated at low HF by the contribution of the mast.

Author (CISTI)

**N94-22391#** Argonne National Lab., IL. Energy Systems Div.  
**EXPERIMENTAL EVALUATION OF OXYGEN-ENRICHED AIR AND EMULSIFIED FUELS IN A SIX-CYLINDER DIESEL ENGINE**

R. R. SEKAR, W. W. MARR, R. L. COLE, T. J. MARCINIAK, and D. E. LONGMAN (AutoResearch Labs., Inc., Chicago, IL.) Jan.

1993 356 p

(Contract W-31-109-ENG-38)

(DE94-000907; ANL/ESD/TM-53) Avail: CASI HC A16/MF A03

The objectives of this investigation are to (1) determine the technical feasibility of using oxygen-enriched air to increase the efficiency of and reduce emissions from diesel engines, (2) examine the effects of water-emulsified fuel on the formation of nitrogen oxides in oxygen-enriched combustion, and (3) investigate the use of lower-grade fuels in high-speed diesel engines by emulsifying the fuel with water. These tests, completed on a Caterpillar model 3406B, six-cylinder engine are a scale-up from previous, single-cylinder-engine tests. The engine was tested with (1) intake-air oxygen levels up to 30%, (2) water content up to 20% of the fuel, (3) three fuel-injection timings, and (4) three fuel-flow rates (power levels). The Taguchi technique for experimental design was used to minimize the number of experimental points in the test matrix. Four separate test matrices were run to cover two different fuel-flow-rate strategies and two different fuels (No. 2 diesel and No. 6 diesel). A liquid-oxygen tank located outside the test cell supplied the oxygen for the tests. The only modification of the engine was installation of a pressure transducer in one cylinder. All tests were run at 1800 rpm, which corresponds to the synchronous speed of a 60-Hz generator. Test results show that oxygen enrichment results in power increases of 50% or more while significantly decreasing the levels of smoke and particulates emitted. The increase in power was accompanied by a small increase in thermal efficiency. Maximum engine power was limited by the test-cell dynamometer capacity and the capacity of the fuel-injection pump. Oxygen enrichment increases nitrogen-oxide emissions significantly. No adverse effects of oxygen enrichment on the turbocharger were observed. The engine operated successfully with No. 6 fuel, but it operated at a lower thermal efficiency and emitted more smoke and particulates than with No. 2 fuel.

DOE

**N94-22405#** Sandia National Labs., Albuquerque, NM.**FLOW AND HEAT TRANSFER MODEL FOR A ROTATING CRYOGENIC MOTOR**

R. C. DYKHUIZEN, R. G. BACA, and T. C. BICKEL Aug. 1993 31 p

(Contract DE-AC04-76DP-00789)

(DE94-001151; SAND-93-1588) Avail: CASI HC A03/MF A01

Development of a high-temperature, superconducting, synchronous motor for large applications (greater than 1000 HP) could offer significant electrical power savings for industrial users. Presently 60% of all electric power generated in the United States is converted by electric motors. A large part of this power is utilized by motors 1000 HP or larger. The use of high-temperature superconducting materials with critical temperatures above that of liquid nitrogen (77 K) in the field winding would reduce the losses in these motors significantly, and therefore, would have a definite impact on the electrical power usage in the U.S. These motors will be 1/3 to 1/2 the size of conventional motors of similar power and, thus, offer potential savings in materials and floor space. The cooling of the superconducting materials in the field windings of the rotor presents a unique application of cryogenic engineering. The rotational velocity results in significant radial pressure gradients that affect the flow distribution of the cryogen. The internal pressure fields can result in significant nonuniformities in the two-phase flow of the coolant. Due to the variable speed design, the flow distribution has the potential to change during operation. A multiphase-flow computer model of the cryogenic cooling is developed to calculate the boiling heat transfer and phase distribution of the nitrogen coolant in the motor. The model accounts for unequal phase velocities and nonuniform cooling requirements of the rotor. The unequal radial pressure gradients in the inlet and outlet headers result in a larger driving force for flow in the outer cooling channels. The effect of this must be accounted for in the design of the motor. Continuing improvements of the model will allow the investigation of the transient thermal issues associated with localized quenching of the superconducting components of the motor.

DOE

**N94-22577** Toronto Univ. (Ontario). Dept. of Aerospace Science and Engineering.**THE OPTOHYDRAULIC SERVOVALVE: A NOVEL DEVICE FOR THE PRECISE OPTICAL CONTROL OF HYDRAULIC PRESSURE**

M.S. Thesis

SONNY HANSENG CHEE 1992 154 p

(ISBN-0-315-83580-X; CTN-94-60943) Copyright Avail:

Micromedia Ltd., Technical Information Centre, 240 Catherine Street, Suite 305, Ottawa, Ontario, K2P 2G8, Canada HC/MF

In the development of opto-fluidic systems for flight control, the main bottleneck has been the lack of a suitable optomechanical interface and actuator. A novel optomechanical actuator is proposed, the optohydraulic servovalve (OHS), which could have flight control applications. The device consists of the mating of an optomechanical interface, the optothermic gas cell (Ocell), with a jet pipe servovalve. A review is presented of known optical to mechanical transduction mechanisms; a qualitative and quantitative comparison indicates that the Ocell has superior characteristics for interfacing with a servovalve. The Ocell constitutive relations describing pressure, diaphragm displacement, and bandwidth with respect to input optical power were also developed and verified experimentally. Mathematical models developed for the OHS are described, and it is shown numerically that the OHS can be operated by as little as 10 mW of optical power. Some experimental Ocells were designed and constructed, and it was demonstrated that a pair of Ocells could replace the torque motor in a standard electrohydraulic servovalve and thereby result in a new device.

Author (CISTI)

**N94-22603#** Airbus Industrie, Toulouse (France).**UTILIZATION OF LASERS FOR AIR DATA MEASUREMENTS [EINSATZ VON LASERN BEI LUFTDATENMESSUNGEN]**

J. HAMMER In Tech. Univ. Berlin, Measurement Technology for Flight Tests p 64-81 May 1991 In GERMAN

Avail: CASI HC A03/MF A02

The operating principles of the ALEV3 three axis laser Doppler anemometer, which was designed for flight tests with the A-320 and A-340 aircraft, are depicted. If mounted on the aircraft center of gravity, the ALEV-3 allows true flight velocity in three directions and angles of attack and sideslip to be directly measured with a very good accuracy, in particular flight areas such as limit buffeting, stall, high Mach numbers, or sideslip flights. Aircraft parameter estimation, calculation, and calibration results are presented. The accuracies of velocity, static pressure and aerodynamic angle measurements were compared with classical anemometers precisions. Flight tests results of the ALEV-1 one axis laser anemometer for A-320 are given as a reference.

ESA

**N94-22604#** Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany).**HOT WIRE ANEMOMETRY: A VERSATILE INSTRUMENTATION USED FOR PREDEVELOPMENT STUDIES AND FLIGHT TESTING OF THE DO-328 AIRCRAFT****[HITZDRAHTANEMOMETRIE: EIN VIELSEITIGES INSTRUMENTARIUM IM EINSATZ BEI VORENTWICKLUNG UND FLUGVERSUCH DER DO 328]**

P. DICK In Tech. Univ. Berlin, Measurement Technology for Flight Tests p 82-96 May 1991 In GERMAN

Avail: CASI HC A03/MF A02

The qualities of hot wire anemometry measuring techniques for laboratory experiments, mock-ups, and flight tests are examined in the framework of the development of the Do-328 regional airliner. Probes for velocity measurements were calibrated in a small wind tunnel. The wind tunnel was designed to produce very low flow velocities. The method is shown to be particularly useful in the following cases: multichannel flowmeters for measuring the trim of air flux in tube systems; ventilation comfort indicators in an aircraft cabin; and test instruments for the flow configuration in free flow and boundary layers.

ESA

**N94-22606#** Saab-Scania, Linköping (Sweden). Ground and Flight Testing Dept.

**IMAGE PROCESSING AS A TOOL IN FLIGHT TESTING EVALUATION**

ANDERS KAELLD AHL /In Tech. Univ. Berlin, Measurement Technology for Flight Tests p 111-117 May 1991  
Avail: CASI HC A02/MF A02

An advanced system for digitizing and automatically analyzing film and video images and its adaptation for specific purposes are described. A video camera of charge coupled devices type was installed in a Viggen test aircraft and flight tests of sensitivity for different wavelengths and measurable resolution were carried out. A video tape containing interesting runs was input into an image processing system in order to show that the video based system meets the specification for Head Up Display (HUD) evaluation. A market investigation was undertaken for an image processing system for HUD evaluation, with particular requirements on a high performance time base corrector in the video input unit, video disks, image processor, and display unit. A digital video disk system and a tracking algorithm based on correlation methods were chosen; the image processing system was completed with a film scanner for converting cinema films into a digital format. In addition to the HUD analysis technique, a photogrammetric system was used for testing microwave landing, radar altimeter, or third category landing system. It is concluded that this image processing system provides evaluation time reduction, higher possibility for correct evaluation and higher accuracy since more points from each image are used. ESA

**N94-22608\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**COMPUTATIONAL METHODS FOR FAILURE ANALYSIS AND LIFE PREDICTION**

AHMED K. NOOR, comp. (Virginia Univ., Hampton.), CHARLES E. HARRIS, comp., JERROLD M. HOUSNER, comp., and DALE A. HOPKINS, comp. (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Washington Oct. 1993 334 p Workshop held in Hampton, VA, 14-15 Oct. 1992 Sponsored by NASA, Washington and Virginia Univ. (Contract RTOP 505-63-50-17) (NASA-CP-3230; L-17321; NAS 1.55:3230) Avail: CASI HC A15/MF A03

This conference publication contains the presentations and discussions from the joint UVA/NASA Workshop on Computational Methods for Failure Analysis and Life Prediction held at NASA Langley Research Center 14-15 Oct. 1992. The presentations focused on damage failure and life predictions of polymer-matrix composite structures. They covered some of the research activities at NASA Langley, NASA Lewis, Southwest Research Institute, industry, and universities. Both airframes and propulsion systems were considered.

**N94-22609\*#** Boeing Commercial Airplane Co., Seattle, WA. Advanced Composites Stress Group.

**NONLINEAR AND PROGRESSIVE FAILURE ASPECTS OF TRANSPORT COMPOSITE FUSELAGE DAMAGE TOLERANCE**

TOM WALKER, L. ILCEWICZ, DAN MURPHY (Boeing Computer Services Co., Seattle, WA.), and BERNHARD DOPKER (Boeing Computer Services Co., Seattle, WA.) /In NASA. Langley Research Center, Computational Methods for Failure Analysis and Life Prediction p 11-35 Oct. 1993  
Avail: CASI HC A03/MF A03

The purpose is to provide an end-user's perspective on the state of the art in life prediction and failure analysis by focusing on subsonic transport fuselage issues being addressed in the NASA/Boeing Advanced Technology Composite Aircraft Structure (ATCAS) contract and a related task-order contract. First, some discrepancies between the ATCAS tension-fracture test database and classical prediction methods is discussed, followed by an overview of material modeling work aimed at explaining some of these discrepancies. Finally, analysis efforts associated with a pressure-box test fixture are addressed, as an illustration of

modeling complexities required to model and interpret tests.

Author (revised)

**N94-22615\*#** Pratt and Whitney Aircraft, West Palm Beach, FL. LIFE PREDICTION SYSTEMS FOR CRITICAL ROTATING COMPONENTS

SUSAN E. CUNNINGHAM /In NASA. Langley Research Center, Computational Methods for Failure Analysis and Life Prediction p 165-184 Oct. 1993

Avail: CASI HC A03/MF A03

With the advent of advanced materials in rotating gas turbine engine components, the methodologies for life prediction of these parts must also increase in sophistication and capability. Pratt & Whitney's view of generic requirements for composite component life prediction systems are presented, efforts underway to develop these systems are discussed, and industry participation in key areas requiring development is solicited. Author (revised)

**N94-22616\*#** Southwest Research Inst., San Antonio, TX. RECENT ADVANCES IN COMPUTATIONAL STRUCTURAL RELIABILITY ANALYSIS METHODS

BEN H. THACKER, Y.-T. WU, HARRY R. MILLWATER, TONY Y. TORNG, and DAVID S. RIHA /In NASA. Langley Research Center, Computational Methods for Failure Analysis and Life Prediction p 185-203 Oct. 1993

Avail: CASI HC A03/MF A03

The goal of structural reliability analysis is to determine the probability that the structure will adequately perform its intended function when operating under the given environmental conditions. Thus, the notion of reliability admits the possibility of failure. Given the fact that many different modes of failure are usually possible, achievement of this goal is a formidable task, especially for large, complex structural systems. The traditional (deterministic) design methodology attempts to assure reliability by the application of safety factors and conservative assumptions. However, the safety factor approach lacks a quantitative basis in that the level of reliability is never known and usually results in overly conservative designs because of compounding conservatism. Furthermore, problem parameters that control the reliability are not identified, nor their importance evaluated. A summary of recent advances in computational structural reliability assessment is presented. A significant level of activity in the research and development community was seen recently, much of which was directed towards the prediction of failure probabilities for single mode failures. The focus is to present some early results and demonstrations of advanced reliability methods applied to structural system problems. This includes structures that can fail as a result of multiple component failures (e.g., a redundant truss), or structural components that may fail due to multiple interacting failure modes (e.g., excessive deflection, resonate vibration, or creep rupture). From these results, some observations and recommendations are made with regard to future research needs. Author (revised)

**N94-22617\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**AN OVERVIEW OF COMPUTATIONAL SIMULATION METHODS FOR COMPOSITE STRUCTURES FAILURE AND LIFE ANALYSIS**

CHRISTOS C. CHAMIS /In NASA. Langley Research Center, Computational Methods for Failure Analysis and Life Prediction p 205-223 Oct. 1993

Avail: CASI HC A03/MF A03

Three parallel computational simulation methods are being developed at the LeRC Structural Mechanics Branch (SMB) for composite structures failure and life analysis: progressive fracture CODSTRAN; hierarchical methods for high-temperature composites; and probabilistic evaluation. Results to date demonstrate that these methods are effective in simulating composite structures failure/life/reliability. Author (revised)

## 12 ENGINEERING

**N94-22621\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

### **NASA LANGLEY DEVELOPMENTS IN RESPONSE CALCULATIONS NEEDED FOR FAILURE AND LIFE PREDICTION**

JERROLD M. HOUSNER *In its Computational Methods for Failure Analysis and Life Prediction* p 285-310 Oct. 1993  
Avail: CASI HC A03/MF A03

NASA Langley developments in response calculations needed for failure and life predictions are discussed. Topics covered include: structural failure analysis in concurrent engineering; accuracy of independent regional modeling demonstrated on classical example; functional interface method accurately joins incompatible finite element models; interface method for insertion of local detail modeling extended to curve pressurized fuselage window panel; interface concept for joining structural regions; motivation for coupled 2D-3D analysis; compression panel with discontinuous stiffener coupled 2D-3D model and axial surface strains at the middle of the hat stiffener; use of adaptive refinement with multiple methods; adaptive mesh refinement; and studies on quantity effect of bow-type initial imperfections on reliability of stiffened panels. Author (revised)

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### **GEOSCIENCES**

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

**N94-20948#** Federal Aviation Administration, Washington, DC. Office of Environment and Energy.

### **EDMS MICROCOMPUTER POLLUTION MODEL FOR CIVILIAN AIRPORTS AND AIR FORCES BASES: USER'S GUIDE, SUPPLEMENT A**

H. M. SEGAL Jul. 1993 28 p  
(AD-A271596; DOT/FAA/EE-91-3-SUPPL-A;  
AFESC/ESL-TR-91-31-SUPPL-A) Avail: CASI HC A03/MF A01

This supplement announces the incorporation of the latest aircraft emission database (EPA, 1992) and the latest motor vehicle database (Mobile 5a) into the Emissions and Dispersion Modeling System (EDMS). (The Clean Air Act Amendments of 1990 requires that the latest emission information be used to establish the Conformity of an airport improvement project with the State Implementation Plan.) This supplement also documents the following model enhancements: (1) an expansion of the emissions inventory portion of the model to accommodate ground support equipment and airport spray painting facilities; (2) the condensation of the emissions report into a one page printout; (3) the summarizing of calculated concentrations into hourly average time periods associated with each pollutant; (4) the access of the dispersion output file (disperse.out) directly from the menu; (5) the addition of a gridding algorithm designed to permit the entry of up to 200 receptors into the model; (6) the expansion of the example problem procedure to accommodate gridding. DTIC

### **N94-21453** Aeronautical Research Labs., Melbourne (Australia). **DETECTING TOPOGRAPHICAL REGIONS IN DIGITAL TERRAIN MAPS**

SABRINA SESTITO, SIMON GOSS, and TERRY CAELLI Aug. 1993 25 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality  
(AD-A272889; ARL-TR-53; DODA-AR-008-387) Avail: CASI HC A03

This report describes an application of Clustering and Differential Geometry to the characterization of digital terrain maps by different surface types and critical regions. Of particular interest is the determination of specific terrain types, where they occur, and describing them in ways which are invariant to viewing position.

The development of robust and efficient segmentation and associated region characterization procedures is reported. Good results have been obtained for characterizing digital terrain maps. This work supports the development of techniques for generating optimal flight paths. DTIC

**N94-21519#** Federal Aviation Administration, Atlanta, GA.

### **NEXT GENERATION WEATHER RADAR (NEXRAD) PRINCIPAL USER PROCESSOR (PUP) OPERATIONAL TEST AND EVALUATION (OT/E) Operational Report**

BAXTER STRETCHER Oct. 1993 38 p  
(AD-A273075; DOT/FAA/CT-TN93/36) Avail: CASI HC A03/MF A01

This report details the results of the Operational Test and Evaluation (OT&E) Operational Test of the Next Generation Weather Radar (NEXRAD), Principle User Processor (PUP). The PUP was evaluated at the Leesburg, Virginia, and Houston, Texas, Air Route Traffic Control Centers (ARTCC) during the period 22 Mar. through 1 Apr. 1993. The objective of the OT&E Operational Test was to obtain the Central Weather Service Unit (CWSU) meteorologists' evaluation of the NEXRAD PUP. A questionnaire was used to obtain responses from the meteorologists. This report includes the meteorologists' evaluation of the quality and quantity of the products provided by the PUP, the workload, operational procedures, radar connections, and training. DTIC

**N94-22280** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abt. Wolkenphysik.

### **A DOCUMENTATION OF ICING RELEVANT CLOUD PHYSICAL PARAMETERS ON HORIZONTAL SOUNDINGS OF STRATIFORM CLOUDS (CONTINUATION) [EINE DOKUMENTATION VEREISUNGSRELEVANTER WOLKENPHYSIKALISCHER PARAMETER BEI HORIZONTALSONDIERUNGEN STRATIFORMER WOLKEN (FORTSETZUNG)]**

HANS-EBERHARD HOFFMANN and JOHANN DEMMEL Aug. 1992 83 p In GERMAN Limited Reproducibility: More than 20% of this document may be affected by poor print  
(ISSN 0939-298X)  
(DLR-MITT-92-10; ETN-93-94458) Avail: Issuing Activity  
(European Space Agency (ESA)); DLR, Zentrale Allgemeine Dieste, Versand, Postfach 90 60 58, 5000 Cologne 90, Germany, HC

The results of 22 further horizontal soundings were arranged according to their synoptic conditions. Among the results were the following: in clouds of a high pressure area, on flight paths between 40 and 75 km and when the distance from the cloud base was constant, the total water content (TWC) fluctuated between approximately equal to 0.10 and approximately equal to 0.18 g/cu m and between approximately equal to 0.10 and approximately 0.25 g/cu m respectively. The value for the median volume diameter (MVD) was always small, between 8 and 20 micrometers. In the vicinity of cold and warm fronts or in flow from different directions, the value of TWC fluctuated between 0 and 0.10 g/cu m up to between 0 and 0.55 g/cu m on flight distances between 35 and 145 km. The value of MVD had small or large values on flight distances of different length or fluctuated between small values (8 to 50 micrometers) and larger values (up to 600 micrometers). ESA

**N94-22293\*#** National Center for Atmospheric Research, Boulder, CO.

### **OVERVIEW OF MICROPHYSICAL AND STATE PARAMETER MEASUREMENTS FROM FIRE 2**

ANDREW J. HEYMSFIELD and LARRY M. MILOSHEVICH *In NASA. Langley Research Center, The FIRE Cirrus Science Results* 1993 p 1-4 Dec. 1993  
Avail: CASI HC A01/MF A03

In this article we present data collected by the NCAR King Air and Sabreliner aircraft in the FIRE 2 cirrus project over southeastern Kansas and northeastern Oklahoma in Nov. and Dec. of 1991. We present state parameter and microphysical measurements in summary form for the dates which have been selected by the

FIRE Science Team for intensive analysis, 25 and 26 Nov. and 5 and 6 Dec. We will also evaluate the performance of 'key' aircraft instrumentation. Author (revised)

**N94-22296\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**BI-DIRECTIONAL REFLECTANCE AND OTHER RADIATION PARAMETERS OF CIRRUS FROM ER-2 OBSERVATIONS**

JAMES SPINHIME *In* NASA. Langley Research Center, The FIRE Cirrus Science Results 1993 p 13-16 Dec. 1993  
Avail: CASI HC A01/MF A03

Passive and active remote sensing of cirrus were acquired from the ER-2 high altitude aircraft in the 1991 Cirrus Experiment. The observations include direct measurements of cirrus bi-directional reflectance from a new translinear scanning radiometer and the previously employed measurements by lidar and visible-infrared imaging radiometers. For any cirrus radiative transfer application, it is necessary to know the appropriate model for visible reflectance in relation to angle and also the optical thickness and infrared emissivity of the clouds. At a more complicated level, for remote sensing and overall cloud effects it is ultimately required to understand effects from multiple cloud layers, broken clouds, and variable microphysics. Our overall data set from the scanning radiometers and lidar is intended to provide the necessary observations to investigate these problems.

Author (revised)

**N94-22297\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**OPTICAL PROPERTIES OF CIRRUS DERIVED FROM AIRBORNE MEASUREMENTS DURING FIRE IFO 2**

FRANCISCO P. J. VALERO, PETER PILEWSKIE, ANTHONY BUCHOLTZ, and STEVEN PLATNICK *In* NASA. Langley Research Center, The FIRE Cirrus Science Results 1993 p 17-19 Dec. 1993

Avail: CASI HC A01/MF A03

The Radiation Measurement System (RAMS) on board the NASA ER-2 was used to acquire several optical parameters of interest during the FIRE Cirrus IFO 2. In this abstract we present results from the 26 Nov. IFO when the ER-2 flew over the Coffeyville airport hub site. We show retrieved optical thickness and cloud temperature, along with optical thickness obtained from RAMS instruments on the NCAR Sabreliner and at the surface site B. Independent retrieval of optical thickness, from the ER-2 and at the surface, are in agreement during the overpasses. Cirrus optical depths, derived from each platform, ranged between 1 and 2.

Author (revised)

**N94-22298\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**INTERCOMPARISON OF MAS, AVIRIS, AND HIS DATA FROM FIRE CIRRUS 2**

LIAM E. GUMLEY (Research and Data Systems, Inc., Greenbelt, MD.), MICHAEL D. KING, SI-CHEE TSAY, BO-CAI GAO, and G. THOMAS ARNOLD (Applied Research Corp., Landover, MD.) *In* NASA. Langley Research Center, The FIRE Cirrus Science Results 1993 p 20-23 Dec. 1993

Avail: CASI HC A01/MF A03

The NASA ER-2 flight on 5 Dec. 1991 is unique among the FIRE Cirrus 2 missions in that data were acquired simultaneously by the MODIS Airborne Simulator (MAS), the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS), and the High Resolution Interferometer Sounder (HIS). These data represent a unique source of information about the spatial and spectral properties of cirrus clouds. The MAS is a new instrument which will aid in defining algorithms and building an understanding of the ability of the Moderate Resolution Imaging Spectroradiometer (MODIS) to remotely sense atmospheric conditions for assessing global change. In order to establish confidence in the absolute calibration accuracy of the MAS radiances, an inter-comparison of MAS radiances with AVIRIS and HIS has been undertaken.

Author (revised)

**N94-22299\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**COMPARISON OF RADIATION AND CLOUD PARAMETERS DERIVED FROM SATELLITE AND AIRCRAFT MEASUREMENTS DURING FIRE 2 CIRRUS IFO**

PATRICK W. HECK (Lockheed Engineering and Sciences Co., Hampton, VA.), SHALINI MAYOR (Lockheed Engineering and Sciences Co., Hampton, VA.), DAVID F. YOUNG (Lockheed Engineering and Sciences Co., Hampton, VA.), PATRICK MINNIS, YOSHIHIDE TAKANO (Utah Univ., Salt Lake City.), KUO-NAN LIOU (Utah Univ., Salt Lake City.), and JAMES D. SPINHIRE (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) *In* *its* The FIRE Cirrus Science Results 1993 p 24-27 Dec. 1993

Avail: CASI HC A01/MF A03

Meteorological satellite instrument pixel sizes are often much greater than the individual cloud elements in a given scene. Partially cloud-filled pixels can be misinterpreted in many analysis schemes because the techniques usually assume that all of the cloudy pixels are cloud filled. Coincident Landsat and Geostationary Operational Environmental Satellite (GOES) data and degraded-resolution Landsat data were used to study the effects of both sensor resolution and analysis techniques on satellite-derived cloud parameters. While extremely valuable for advancing the understanding of these effects, these previous studies were relatively limited in the number of cloud conditions that were observed and by the limited viewing and illumination conditions. During the First ISCCP Regional Experiment (FIRE) Phase 2 (13 Nov. - 7 Dec. 1991), the NASA ER-2 made several flights over a wide range of cloud fields and backgrounds with several high resolution sensors useful for a variety of purposes including serving as ground truth for satellite-based cloud retrievals. This paper takes a first look at utilizing the ER-2 for validating cloud parameters derived from GOES and NOAA-11 Advanced Very High Resolution Radiometer (AVHRR) data.

Author (revised)

**N94-22302\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**CLOUD FIELDS DERIVED FROM SATELLITE AND SURFACE DATA DURING FIRE CIRRUS PHASE 2**

PATRICK MINNIS, WILLIAM L. SMITH, JR. (Lockheed Engineering and Sciences Co., Hampton, VA.), DAVID F. YOUNG (Lockheed Engineering and Sciences Co., Hampton, VA.), and PATRICK W. HECK (Lockheed Engineering and Sciences Co., Hampton, VA.) *In* *its* The FIRE Cirrus Science Results 1993 p 36-39 Dec. 1993

Avail: CASI HC A01/MF A03

The interpretation of surface and aircraft measurements of cloud properties taken during field programs must take into account the large-scale cloud and meteorological conditions. Cloud properties are also required at scales beyond the point and line data taken from ground and aircraft platforms. Satellite data can provide a quantitative description of these large-scale cloud properties. When derived from geostationary satellite data, the cloud fields constitute a unique source for evaluating the development and demise of a cloud system. Satellites, however, can only see the tops of clouds, so that cloud layers below the uppermost cloud deck may remain undetected resulting in an incomplete depiction of the cloud system. Some multilayer clouds are amenable to detection from satellites. Many, especially in midlatitude cyclonic systems, can only be observed from the surface. A combination of surface and satellite cloud observations should be the most complete quantification of large-scale cloudiness if there are sufficient surface measurements. During the First International Satellite Cloud Climatology Project (ISCCP) Regional Experiment Phase 2 (FIRE-2) Cirrus Intensive Field Observation (IFO) period (November 13 - December 7, 1991) conducted at Coffeyville, Kansas, cirrus observations were taken in a variety of conditions. The IFO area was selected for a variety of reasons including the relatively dense network of surface weather stations and special surface instrumentation sites. Thus, the FIRE-2 IFO presents an excellent opportunity to combine cloud



observations from surface and satellite observations. This paper presents an analysis of cloud properties on a mesoscale grid using satellite cloud property retrievals, surface observer data, and rawinsonde temperature and humidity profiles. Derived from text

**N94-22303\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**REMOTE SENSING OF MULTILEVEL CLOUDS DURING FIRE IFO 2**

BRYAN A. BAUM, J. TITLOW (Lockheed Engineering and Sciences Co., Hampton, VA.), V. TOVINKERE (Lockheed Engineering and Sciences Co., Hampton, VA.), M. POELLOT (North Dakota Univ., Grand Forks.), T. P. ACKERMAN (Pennsylvania State Univ., University Park.), J. ALVAREZ, T. UTTAL (National Oceanic and Atmospheric Administration, Boulder, CO.), and J. INTRIERI (Colorado Univ., Boulder.) *In its* The FIRE Cirrus Science Results 1993 p 40-43 Dec. 1993  
 Avail: CASI HC A01/MF A03

An unresolved difficulty in the remote sensing of clouds concerns the inability of the cloud retrieval algorithms to adequately recognize and analyze scenes containing overlapping cloud layers. Most cloud retrieval schemes, such as that used by the International Satellite Cloud Climatology Project (ISCCP) assume that each picture element (pixel) contains a single cloud layer. The current study begins to address the complexities of multilayered cloud property retrieval through the application of a modified multispectral, multiresolution (MSMR) method, first detailed in Baum et al. (1992), which merges 1.1-km (at nadir) spectral data from the Advanced Very High Resolution Radiometer (AVHRR) with 17.4-km (at nadir) High Resolution Infrared Radiometer Sounder (HIRS/2, henceforth HIRS). Both instruments are flown aboard the National Oceanic and Atmospheric Administration (NOAA) polar-orbiting platforms. An ideal case study for this investigation is provided by the NOAA-11 overpass at 20:48 UTC on November 28, 1991. At this time, a large-scale cirrostratus veil overlaid a low-level stratus deck over much of the IFO region. There were both surface lidar and radar observations of the clouds as well as University of North Dakota (UND) Citation aircraft measurements. The presence of overlapping cloud layers within a HIRS FOV is determined from colocated AVHRR spectral data through the use of a fuzzy logic expert system. Conventional algorithms such as spatial coherence and CO<sub>2</sub> slicing are used to retrieve cloud pressure and height for each identified cloud layer. The results from the satellite cloud retrieval analysis are compared to results from both surface- and aircraft-based measurements. Derived from text

**N94-22307\*#** Wisconsin Univ., Madison. Cooperative Inst. for Meteorological Satellite Studies.

**CIMSS FIRE RESEARCH ACTIVITIES**

W. L. SMITH, S. A. ACKERMAN, R. O. KNUTESON, X. L. MA, and H. E. REVERCOMB *In* NASA. Langley Research Center, The FIRE Cirrus Science Results 1993 p 56-61 Dec. 1993  
 Avail: CASI HC A02/MF A03

An overview of the Cooperative Institute for Meteorological Satellite Studies' FIRE research activities is presented. Emphasis is on the analysis of the High-Resolution Interferometer Sounder (HIS) made from the ER-2 as well as ground based measurements made by the Atmospheric Emitted Radiance Interferometer (AERI) prototype. Author (revised)

**N94-22311\*#** National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.

**OBSERVATIONS OF MULTI-LAYERED CLOUDS USING K-BAND RADAR**

BROOKS E. MARTNER and ROBERT A. KROPFLI *In* NASA. Langley Research Center, The FIRE Cirrus Science Results 1993 p 75-82 Dec. 1993 See also N93-23070 Sponsored in part by FAA, DOE, and NOAA  
 Avail: CASI HC A02/MF A03

Rudimentary ground-based K-band radars were once used by the U.S. Air Force to monitor clouds over air bases. The NOAA wave Propagation Laboratory has developed a significantly advanced dual-polarization Doppler K-band system that provides

remarkably detailed visualizations of the structure and kinematics of nonprecipitating and weakly precipitating clouds. Unlike lidar and infrared radiometer systems, K-band radar can penetrate liquid water cloud layers and obtain measurements through moderate rainfall and heavy snowfall to reveal intricate cloud features including multiple layers of cloud. This is accomplished at less cost than would be possible with traditional longer wavelength weather radars. The radar's capabilities have been demonstrated in several recent cloud research field projects. In combination with measurements by other remote sensors, the radar can help detect aircraft icing hazards and infer microphysical properties of clouds. An automated, unattended version of the radar could provide a continuous, detailed depiction of the cloud environment in the vicinity of airports. Author (revised)

**N94-22344\*#** National Aeronautics and Space Administration, Washington, DC.

**AN OVERVIEW OF THE RADIATION COMPONENT OF THE NASA TOGA-COARE EXPERIMENT**

THOMAS ACKERMAN (Pennsylvania State Univ., University Park.) and JOHN T. SUTTLES *In* NASA. Langley Research Center, The FIRE Cirrus Science Results 1993 p 209-211 Dec. 1993  
 Avail: CASI HC A01/MF A03

During January and February, 1993, the Physical Climate Branch of NASA sponsored an aircraft program in support of the Tropical Ocean - Global Atmosphere (TOGA) Coupled Ocean-Atmosphere Response Experiment (COARE). The NASA program was integrated with and contributed directly to the COARE objectives, but had as its primary foci the measurement of convection and precipitation related to the Tropical Rainfall Measurement Mission (TRMM) and the measurement of the physical and radiative properties of tropical cirrus related to the International Satellite Cloud Climatology Project (ISCCP) and the First ISCCP Regional Experiment (FIRE). This brief overview will concentrate on the measurements associated with FIRE and ISCCP.

Derived from text

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### MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

**N94-20926** Naval Air Warfare Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.

**AN APPLICATION OF THE CEREBELLAR MODEL ARTICULATION CONTROLLER FOR A SWITCHED RELUCTANCE ROTOR POSITION ESTIMATOR**

JENIFER M. SHANNON Nov. 1992 53 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality  
 (AD-A271769; NAWCADWAR-93041-60) Avail: CASI HC A04

A method of estimating the rotor position of a switched reluctance machine without the need for a rotor-mounted position sensor has been developed. This method takes advantage of the information derived from known phase voltage and current waveforms. The information is fed as the inputs to a neural network, which after being trained, can correctly map the rotor position to its output. The most accurate mapping results were obtained using a Cerebellar Model Articulation Controller (CMAC) neural network. The performance of the neural network has been tested with measured waveforms from a three phase 120 HP switched reluctance motor. It successfully maps the rotor position with an average root mean square error of one tenth of a mechanical degree. DTIC

**N94-22100\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**INTRODUCTION TO THE LARC CENTRAL SCIENTIFIC COMPUTING COMPLEX**

JOHN N. SHOOSMITH Nov. 1993 55 p Revised  
(Contract RTOP 505-60-01-01)  
(NASA-TM-104092-REV-1; NAS 1.15:104092-REV-1) Avail: CASI HC A04/MF A01

The computers and associated equipment that make up the Central Scientific Computing Complex of the Langley Research Center are briefly described. The electronic networks that provide access to the various components of the complex and a number of areas that can be used by Langley and contractors staff for special applications (scientific visualization, image processing, software engineering, and grid generation) are also described. Flight simulation facilities that use the central computers are described. Management of the complex, procedures for its use, and available services and resources are discussed. This document is intended for new users of the complex, for current users who wish to keep apprised of changes, and for visitors who need to understand the role of central scientific computers at Langley.

Author (revised)

**N94-22353\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**UNSTRUCTURED GRID RESEARCH AND USE AT NASA LEWIS RESEARCH CENTER**

MARK G. POTAPCZUK *In* NASA. Langley Research Center, Unstructured Grid Generation Techniques and Software p 43-55 Sep. 1993

Avail: CASI HC A03/MF A03

Computational fluid dynamics applications of grid research at LRC include inlets, nozzles, and ducts; turbomachinery; propellers - ducted and unducted; and aircraft icing. Some issues related to internal flow grid generation are resolution requirements on several boundaries, shock resolution vs. grid periodicity, grid spacing at blade/shroud gap, grid generation in turbine blade passages, and grid generation for inlet/nozzle geometries. Aircraft icing grid generation issues include (1) small structures relative to airfoil chord must be resolved; (2) excessive number of grid points in far-field using structured grid; and (3) grid must be recreated as ice shape grows.

Derived from text

**N94-22359\*#** Vigyan Research Associates, Inc., Hampton, VA. **ROBUST UNSTRUCTURED GRID GENERATION WITH VGRID**

SHAHYAR PIRZADEH *In* NASA. Langley Research Center, Unstructured Grid Generation Techniques and Software p 121-136 Sep. 1993

Avail: CASI HC A03/MF A03

The objective of this work is to develop a robust, user-oriented, unstructured grid-generation technique for fast generation of Euler/viscous grids around complex 2D and 3D configurations. To do this, two different approaches are employed: the advancing-front method for generation of Euler grids; and the advancing-layers method for generation of viscous grids. A discussion of these topics is presented in viewgraph form.

Author (revised)

**N94-22361\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**DEVELOPMENT OF A GRIDLESS CFD METHOD**

JOHN T. BATINA *In* *its* Unstructured Grid Generation Techniques and Software p 151-162 Sep. 1993

Avail: CASI HC A03/MF A03

The objective of this paper is to stimulate ideas concerning alternative approaches to discretizing fluid flow problems, i.e., the so-called gridless approach. The gridless approach uses only clouds of points and does not require that the points be connected to form a grid as is necessary in conventional CFD algorithms. The governing equations are solved directly by performing local least-squares curve fits in each cloud of points and then analytically differentiating the resulting curve fits to approximate the derivatives. A discussion of these topics is presented in viewgraph form.

Derived from text

**N94-22363\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**DYNAMIC MESH ADAPTION FOR TRIANGULAR AND TETRAHEDRAL GRIDS**

RUPAK BISWAS and ROGER STRAWN *In* NASA. Langley Research Center, Unstructured Grid Generation Techniques and Software p 181-192 Sep. 1993

Avail: CASI HC A03/MF A03

The following topics are discussed: requirements for dynamic mesh adaption; linked-list data structure; edge-based data structure; adaptive-grid data structure; three types of element subdivision; mesh refinement; mesh coarsening; additional constraints for coarsening; anisotropic error indicator for edges; unstructured-grid Euler solver; inviscid 3-D wing; and mesh quality for solution-adaptive grids. The discussion is presented in viewgraph form.

Derived from text

**N94-22367\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**THE 3D EULER SOLUTIONS USING AUTOMATED CARTESIAN GRID GENERATION**

JOHN E. MELTON, FRANCIS Y. ENOMOTO, and MARSHA J. BERGER (New York Univ., New York.) *In* NASA. Langley Research Center, Unstructured Grid Generation Techniques and Software p 251-260 Sep. 1993

Avail: CASI HC A02/MF A03

Viewgraphs on 3-dimensional Euler solutions using automated Cartesian grid generation are presented. Topics covered include: computational fluid dynamics (CFD) and the design cycle; Cartesian grid strategy; structured body fit; grid generation; prolate spheroid; and ONERA M6 wing.

CASI

**N94-22370\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**COMPUTATIONAL GEOMETRY ISSUES**

MARY-ANNE K. POSENAU *In* *its* Unstructured Grid Generation Techniques and Software p 291-309 Sep. 1993

Avail: CASI HC A03/MF A03

Presented in viewgraph format are some of the benefits of computational geometry for grid generation, including benefits to grid quality and algorithm efficiency. Many efficient algorithms are available, but it is concluded that high aspect ratio triangulations are not among them.

Derived from text

**N94-22414\*#** Boeing Defense and Space Group, Seattle, WA.

**TOWARDS THE FORMAL VERIFICATION OF THE REQUIREMENTS AND DESIGN OF A PROCESSOR INTERFACE UNIT: HOL LISTINGS**

DAVID A. FURA, PHILLIP J. WINDLEY (Idaho Univ., Moscow.), and GERALD C. COHEN Nov. 1993 179 p

(Contract NAS1-18586; RTOP 505-64-10-07)

(NASA-CR-191466; NAS 1.26:191466) Avail: CASI HC A09/MF A02

This technical report contains the Higher-Order Logic (HOL) listings of the partial verification of the requirements and design for a commercially developed processor interface unit (PIU). The PIU is an interface chip performing memory interface, bus interface, and additional support services for a commercial microprocessor within a fault tolerant computer system. This system, the Fault Tolerant Embedded Processor (FTEP), is targeted towards applications in avionics and space requiring extremely high levels of mission reliability, extended maintenance-free operation, or both. This report contains the actual HOL listings of the PIU verification as it currently exists. Section two of this report contains general-purpose HOL theories and definitions that support the PIU verification. These include arithmetic theories dealing with inequalities and associativity, and a collection of tactics used in the PIU proofs. Section three contains the HOL listings for the completed PIU design verification. Section 4 contains the HOL listings for the partial requirements verification of the P-Port.

Derived from text



## PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

**N94-20523\*#** Cornell Univ., Ithaca, NY. Dept. of Mechanical and Aerospace Engineering.

**ROTORCRAFT NOISE: STATUS AND RECENT DEVELOPMENTS**

ALBERT R. GEORGE, BEN WEL-C. SIM, and DAVID R. POLAK  
27 Dec. 1993 28 p Submitted for publication  
(Contract NAG2-554)  
(NASA-CR-194761; NAS 1.26:194761) Avail: CASI HC A03/MF A01

This paper briefly reviews rotorcraft noise mechanisms and their approximate importance for different types of rotorcraft in different flight regimes. Discrete noise is due to periodic flow disturbances and includes impulsive noise produced by phenomena which occur during a limited segment of a blade's rotation. Broadband noise results when rotors interact with random disturbances, such as turbulence, which can originate in a variety of sources. The status of analysis techniques for these mechanisms are reviewed. Also, some recent progress is presented on the understanding and analysis of tilt rotor aircraft noise due to: (1) recirculation and blockage effects of the rotor flow in hover; and (2) blade-vortex interactions in forward and descending flight.

Author (revised)

**N94-21741\*#** Lockheed Engineering and Sciences Co., Hampton, VA.

**EVALUATION OF A NONLINEAR METHOD FOR THE ENHANCEMENT OF TONAL SIGNAL DETECTION**

DONALD P. GARBER Dec. 1993 27 p  
(Contract NAS1-19000; RTOP 505-63-70-02)  
(NASA-CR-191562; NAS 1.26:191562) Avail: CASI HC A03/MF A01

A method is presented for biasing spectral estimates to enhance detection of tonal signals against a background of broadband noise. In this method, a nonlinear average of an ensemble of individual spectral estimates is made where broadband noise energy is biased downward, pure tone energy is unbiased, and a mixture of the two is biased by an amount that depends on the ratio of tonal energy to broadband energy. The method is analyzed to provide estimates of the extent of tonal signal detection enhancement.

Author

**N94-22053** Harris, Miller, Miller and Hanson, Inc., Lexington, MA.

**AIRCRAFT NOISE EFFECTS ON CULTURAL RESOURCES: RECOMMENDATION AND RATIONALE FOR FURTHER RESEARCH**

CARL E. HANSON, KENNETH W. KING (Interior Dept., Denver, CO.), MARY ELLEN EAGAN, and RICHARD D. HORONJEFF May 1993 15 p See also PB93-205318 and PB93-205334 Prepared in cooperation with National Park Service, Denver, CO Limited Reproducibility: More than 20% of this document may be affected by microfiche quality  
(Contract NPS-CX-2000-0-0025)  
(PB93-205326; HMMH-290940.04-2) Avail: CASI HC A03

The results are ultimately used to estimate the potential for damage to a wide variety of cultural resources from operations of commercial helicopters. Comparison of measured vibration levels with criteria for damage based on structural velocities will provide a family of restrictions on aircraft operations in the vicinity of sensitive structures. Such restrictions could take the form of minimum separation distances and prohibited maneuvers for helicopters. The results of the study would be presented in a

report as a set of recommended procedures for helicopter operations to avoid damage to prehistoric, historic, sensitive, and conventional structures. NTIS

**N94-22054** Harris, Miller, Miller and Hanson, Inc., Lexington, MA.

**AIRCRAFT NOISE EFFECTS ON CULTURAL RESOURCES: ANNOTATED BIBLIOGRAPHY**

C. E. HANSON and N. PETERSON May 1993 24 p See also PB93-205326 and PB93-205318 Sponsored by National Park Service, Denver, CO Limited Reproducibility: More than 20% of this document may be affected by microfiche quality  
(Contract NPS-CX-2000-0-0025)  
(PB93-205334; HMMH-290940.04-3) Avail: Issuing Activity (National Technical Information Service (NTIS))

The scope of work required a review, critique, and analysis of the scientific literature to assess the nature and probable magnitude of the potential effects of aircraft overflights on historical and cultural resources in the National Park System. Excluded under this work order are such items as historical or cultural context or setting. NTIS

## SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

**N94-21821\*#** Massachusetts Inst. of Tech., Cambridge. Human-Machine Systems Lab.

**MODELLING DECISION-MAKING BY PILOTS Progress Report**

NICHOLAS J. M. PATRICK 13 Dec. 1993 28 p  
(Contract NAG2-729)  
(NASA-CR-194767; NAS 1.26:194767) Avail: CASI HC A03/MF A01

Our scientific goal is to understand the process of human decision-making. Specifically, a model of human decision-making in piloting modern commercial aircraft which prescribes optimal behavior, and against which we can measure human sub-optimality is sought. This model should help us understand such diverse aspects of piloting as strategic decision-making, and the implicit decisions involved in attention allocation. Our engineering goal is to provide design specifications for (1) better computer-based decision-aids, and (2) better training programs for the human pilot (or human decision-maker, DM). Author (revised)

## GENERAL

**N94-20543#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Munich (Germany). Abt. Bibliothekswesen.

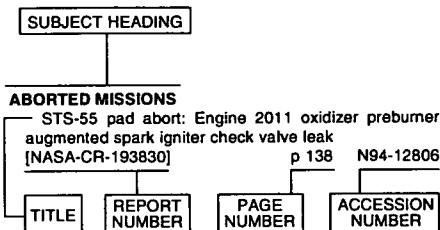
**DOCUMENTS ON THE HISTORY OF AERONAUTICAL AND SPACE RESEARCH IN GERMANY, 1900 - 1970 [DOKUMENTE ZUR GESCHICHTE DER LUFT- UND RAUMFAHRTFORSCHUNG IN DEUTSCHLAND 1900 - 1970]**  
HELMUTH TRISCHLER, ed. (Deutsches Museum, Munich, Germany.) Dec. 1992 435 p In GERMAN  
(ISSN 0939-298X)

(DLR-MITT-92-08; ETN-93-94864) Avail: CASI HC A19/MF A04

The accompanying edition of sources to a reference book on air and aerospace research in Germany, 1900-1970, political history

of science, is presented. 148 unpublished documents on the history of aeronautical and space research in its political context are contained. The main emphasis is put on the era of the 'Third Reich' and the Federal Republic of Germany. More than half of the documents deal with the years after World War Two. ESA

## Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of document content, a title extension is added, separated from the title by three hyphens. The accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence.

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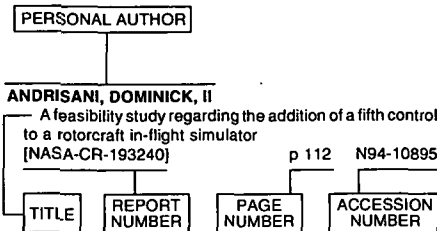


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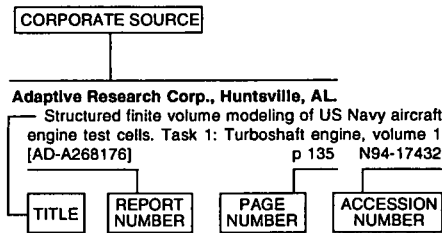
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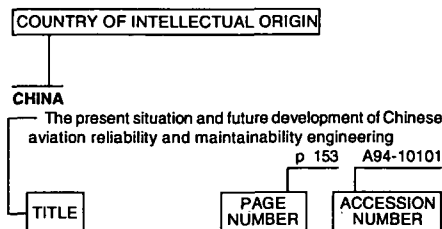
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March 1994

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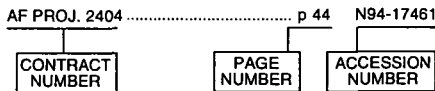
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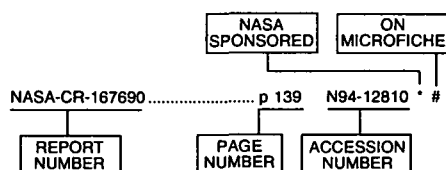
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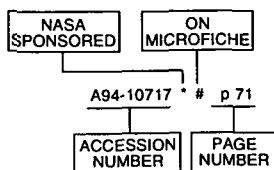
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Missoula, MT 59812-1195  
(406) 243-6700 Fax: (406) 243-2060

## NEBRASKA

### UNIV. OF NEBRASKA - LINCOLN

D.L. Love Memorial Library  
Documents Dept.  
Lincoln, NE 68588  
(402) 472-2562

## NEVADA

### UNIV. OF NEVADA

Reno Library  
Govt. Publications Dept.  
Reno, NV 89557  
(702) 784-6579 Fax: (702) 784-1751

## NEW JERSEY

### NEWARK PUBLIC LIBRARY

U.S. Documents Div.  
5 Washington Street -  
P.O. Box 630  
Newark, NJ 07101-0630  
(201) 733-7812 Fax: (201) 733-5648

## NEW MEXICO

### UNIV. OF NEW MEXICO

General Library  
Govt. Publications Dept.  
Albuquerque, NM 87131-1466  
(505) 277-5441 Fax: (505) 277-6019

### NEW MEXICO STATE LIBRARY

325 Don Gaspar Avenue  
Santa Fe, NM 87503  
(505) 827-3826 Fax: (505) 827-3820

## NEW YORK

### NEW YORK STATE LIBRARY

Documents/Gift & Exchange Section  
Federal Depository Program  
Cultural Education Center  
Albany, NY 12230  
(518) 474-5563 Fax: (518) 474-5786

## NORTH CAROLINA

### UNIV. OF NORTH CAROLINA -

#### CHAPEL HILL

CB#3912, Davis Library  
BA/SS Dept. - Documents  
Chapel Hill, NC 27599  
(919) 962-1151 Fax: (919) 962-0484

## NORTH DAKOTA

### NORTH DAKOTA STATE UNIV. LIB.

Documents Office  
Fargo, ND 58105  
(701) 237-8886 Fax: (701) 237-7138  
In cooperation with Univ. of North  
Dakota, Chester Fritz Library  
Grand Forks

## OHIO

### STATE LIBRARY OF OHIO

Documents Dept.  
65 South Front Street  
Columbus, OH 43266  
(614) 644-7051 Fax: (614) 752-9178

## OKLAHOMA

### OKLAHOMA DEPT. OF LIBRARIES

U.S. Govt. Information Div.  
200 NE 18th Street  
Oklahoma City, OK 73105-3298  
(405) 521-2502, ext. 252, 253  
Fax: (405) 525-7804

### OKLAHOMA STATE UNIV.

Edmon Low Library  
Documents Dept.  
Stillwater, OK 74078  
(405) 744-6546 Fax: (405) 744-5183

## OREGON

### PORTLAND STATE UNIV.

Millar Library  
934 SW Harrison - P.O. Box 1151  
Portland, OR 97207  
(503) 725-3673 Fax: (503) 725-4527

## PENNSYLVANIA

### STATE LIBRARY OF PENN.

Govt. Publications Section  
Walnut St. & Commonwealth Ave. -  
P.O. Box 1601  
Harrisburg, PA 17105  
(717) 787-3752

## SOUTH CAROLINA

### CLEMSON UNIV.

Cooper Library  
Public Documents Unit  
Clemson, SC 29634-3001  
(803) 656-5174 Fax: (803) 656-3025  
In cooperation with Univ. of South  
Carolina, Thomas Cooper Library,  
Columbia

## TENNESSEE

### MEMPHIS STATE UNIV. LIBRARIES

Govt. Documents  
Memphis, TN 38152  
(901) 678-2586 Fax: (901) 678-2511

## TEXAS

### TEXAS STATE LIBRARY

United States Documents  
P.O. Box 12927 - 1201 Brazos  
Austin, TX 78711  
(512) 463-5455 Fax: (512) 463-5436

### TEXAS TECH. UNIV. LIBRARY

Documents Dept.  
Lubbock, TX 79409  
(806) 742-2268 Fax: (806) 742-1920

## UTAH

### UTAH STATE UNIV.

Merrill Library & Learning Resources  
Center, UMC-3000  
Documents Dept.  
Logan, UT 84322-3000  
(801) 750-2684 Fax: (801) 750-2677

## VIRGINIA

### UNIV. OF VIRGINIA

Alderman Library  
Govt. Documents  
Charlottesville, VA 22903-2498  
(804) 824-3133 Fax: (804) 924-4337

## WASHINGTON

### WASHINGTON STATE LIBRARY

Document Section  
MS AJ-11  
Olympia, WA 98504-0111  
(206) 753-4027 Fax: (206) 753-3546

## WEST VIRGINIA

### WEST VIRGINIA UNIV. LIBRARY

Govt. Documents Section  
P.O. Box 6069  
Morgantown, WV 26506  
(304) 293-3640

## WISCONSIN

### ST. HIST. SOC. OF WISCONSIN LIBRARY

Govt. Publications Section  
816 State Street  
Madison, WI 53706  
(608) 262-2781 Fax: (608) 262-4711  
In cooperation with Univ. of Wisconsin -  
Madison, Memorial Library

### MILWAUKEE PUBLIC LIBRARY

Documents Div.  
814 West Wisconsin Avenue  
Milwaukee, WI 53233  
(414) 278-2167 Fax: (414) 278-2137

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